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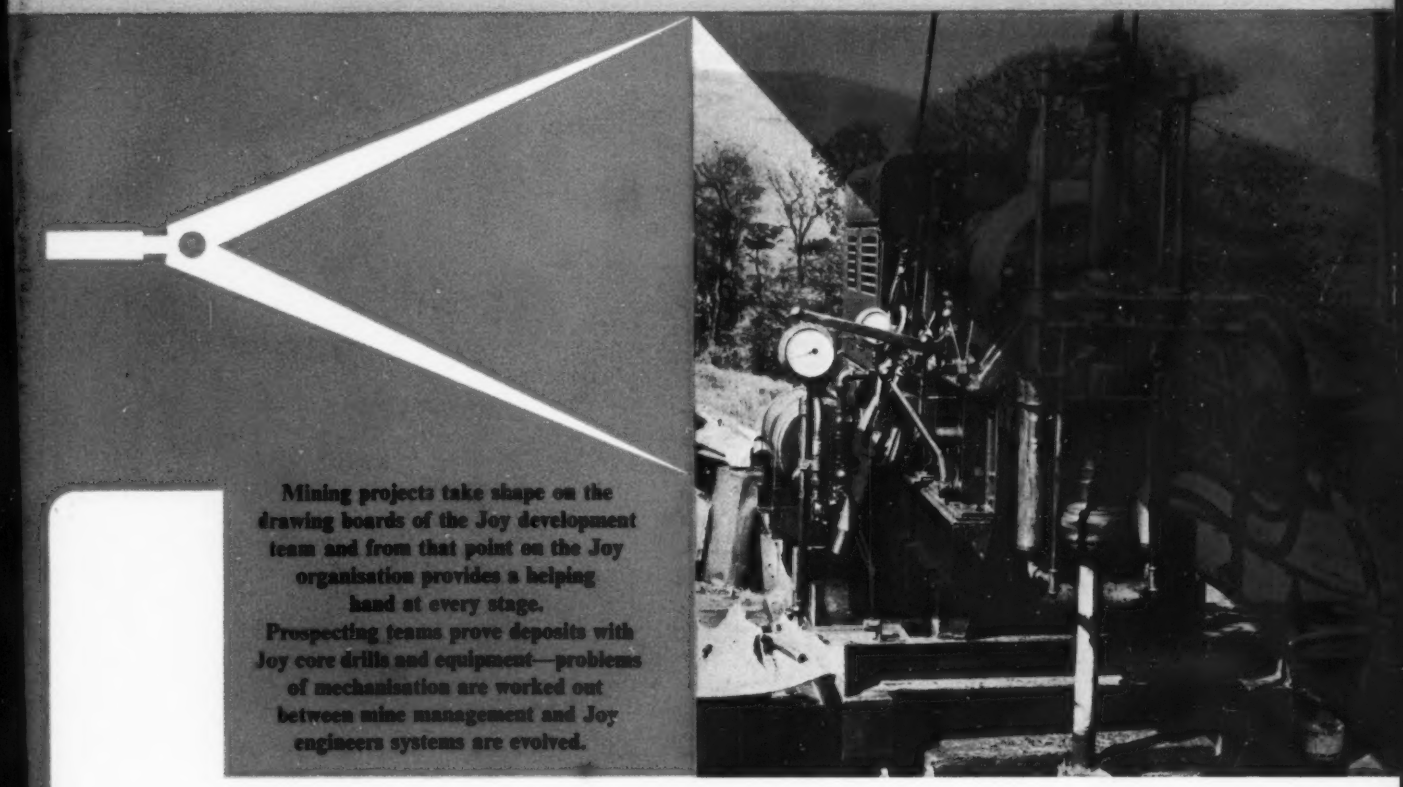

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ANNUAL REVIEW—1958

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A Pause for Reflection

MINING men will, no doubt look back on 1957 and the early months of 1958 as a painful period for their industry, although regrets about the past year may well be over-shadowed by greater anxieties concerning the immediate future. While, in terms of net profits, 1957 was certainly a disappointmen to the miners nearly everywhere, yet it did not compare so unfavourably with other recent years in terms either of production or consumption.

Certainly few new production records were achieved, but equally there were few sharp reductions in consumption outside of certain limited areas of recession in the United States, notably in the automotive and the building industries.

It was of course the precipitous fall in prices, which really hurt the mining industry, and this came about far less through any slackening in actual consumption than in consequence of the industry's productive capacity overhauling and outpacing existing levels of consumption. The seeds of this situation were sown in the period of hectic defence pre-emptions and stockpiling touched off by the Korean war, while today's surplus capacities reflect the radical alterations which have occurred in defence strategies since that time, no less than the completion of stockpile programmes.

Thus the rate of expansion of mining capacities, inflated by stockpile and defence purchasing, has in the present decade borne little relation to the rate of growth in civilian consumption, so that today, with stockpiles swollen and defence agencies largely out of the metal markets (except for a few small tonnage special metals), it is hardly surprising that these greatly expanded capacities should have outstripped present rates of civilian consumption. Moreover, it is characteristic of commodity markets that relatively small surpluses (or shortages) have a quite disproportionate effect on prices. The difficulties of the mining industry have stemmed very largely from this simple fact, and prices have slumped out of all proportion to the relatively slight falling off in actual consumption.

These price falls were aggravated by another unfortunate consequence of the market pressures generated by earlier defence and stockpile buying, namely, the extent to which users of some metals had stocked up in excess of their requirements at almost any price in anticipation of worse shortages to come. When these did not eventuate, the slump in purchasing—as distinct from consumption—was all the sharper.

It has yet to be seen whether we are now near the end of this period of destocking and equally whether the economic recession, which in its early stages was essentially an inventory recession leading into the beginning of a capital goods recession, will now be arrested or whether we are on the verge of plunging into the wider and deeper slump, which could follow a widespread falling off in purchasing power among the major industrial populations of the world. It is this latter contingency which must be a real cause of anxiety for the mining industry. The answer lies largely in America and should be aparent for all to read by this autumn.

Assuming that this greater calamity does not occur, the mining industry might hope to be over the worst of its troubles within the next year. De-stocking cannot go on for ever and, although the capital goods industries may still be at their lowest ebb next spring in consequence of the postponements in the planning of new projects which are occurring now, the natural rate of consumption growth throughout the world is so fundamentally strong (due to population growth and rising living standards) that demand should again overhaul existing production potentials in a comparatively few years. As this stage draws near, the problem for our industry's leaders will be to foresee expanding consumption far enough ahead to lay the plans for further production expansions soon enough to avert yet another crisis of supply.

In seeking to identify the future pattern of demand, we cannot consider metal markets except in a global context in view of the increasing traffic in metals across the Iron Curtain in both directions. Even during periods of theoretical embargo on shipments of metals to Russia, such metals have in the past usually found their way there by more or less devious routes, while now that the changing nature of defence strategy is limiting the commonsense of security embargoes to a much smaller range of metals, the natural inclination of Western countries to expand trade across the Iron Curtain must surely result in an increasing flow of metals in that direction.

Iron Curtain metal exports are, of course, no new phenomenon, and experience of the past year with tin, platinum, aluminium and others suggests that Russia will always be ready to export such commodity surpluses as may arise during periods of short term imbalance in her various production programmes. Indeed, it is interesting to speculate on just how far her recent disposals reflect the running down of the same type of stockpile surpluses which changing defence strategies have brought about in the West, and how far the motive in so doing is to disrupt Western economies as distinct from adjusting balance of payments transactions.

Russia's gold is, of course, mined almost entirely for export and it is no exaggeration to say that her international trade is more nearly on a gold basis than that of any other country. It is indeed this fact coupled with uncertainty as to the precise extent of Russia's gold reserves, which contribute as much as anything to America's continued reluctance to raise the price of gold. It is, however, becoming daily more pertinent to enquire how far the attempt to retain an economic *cordon sanitaire* around Russia and her satellites, which the American attitude to gold implies, is becoming invalidated by changing defence strategy. Certainly the greater catastrophe would be to allow the economy of the West to degenerate into slump.

Strategic considerations apart, a good dose of prosperity and advancing material standards in Russia is probably a far better insurance against war than any plan for the international inspection and control of atomic weapons, and it is only necessary to look at Hungary or Poland to observe the corrosive effect of Western habits and standards upon Communist indoctrination.

There are many economically backward areas of the world on both sides of the Iron Curtain, which would readily grasp the opportunity of advancing on the road to industrialization, and it is on these grounds that everywhere the struggle between East and West is being joined for the political and moral leadership of the underdeveloped areas of the world. In terms both of raw materials and industrial capacity the West is in an infinitely stronger position to embark on such a contest than are Russia and her satellites. It is lack of capital which is the limiting factor, and a substantial rise in the gold price could be the greatest single contribution to resolving it.

In such an event, the Western countries would again quickly be confronted with the familiar problems of an overfull economy — material shortages, labour shortages, insufficient capital equipment. These are the fundamental limitations on advancing economic standards. They can be mitigated only by technological advance, the sweeping away of restrictive practices, and above all by the self restraint of every wage earner in his capacity as consumer. If, in defence of our own way of life, we wish to export our living standards to the underprivileged, we cannot do that and enjoy immediately, in our own homes, the fruits of these exports. Thus in conditions of overfull employment, to which we could so easily return, financial discipline at home must go side by side with the financing of industrial development overseas.

If we pre-suppose a prolonged period of full employment of our resources (such as a rise in the gold price coupled to a constructive approach to the problems of the backward areas could bring about), we shall once more be urgently concerned with the most efficient utilization, and wherever possible the conservation, of our raw materials. This means rationing, and, at least so far as international commodities are concerned,

past experience suggests that rationing by price is the only method which works, rough and ready though its operation may be.

Our London Metal Exchange correspondent deals elsewhere in this *Review* with some of the market dislocations which arise from tampering with the free operation of the price mechanism, whether by price-fixing, long-term contracts, subsidies, tariffs or Government pre-emptions. The twilight condition of limited controls coupled with the restricted operation of free markets, which we have been experiencing in various forms since the war, should by now have made its shortcomings fully manifest alike to governments and industry.

It is often said that free market prices are an unduly sensitive index to changing conditions. Partly this is because market prices are seldom entirely free and consequently present a distorted picture, but equally important is the present lack of any reliable statistical equipment which can measure production, consumption and stock variations as they occur and can maintain a progressively adjusted projection of future requirements and availabilities. Facts are the great market stabilizer, just as uncertainty generates instability. It is obvious that the world's metal statistics must be vastly improved if the mining industry is to be spared the continued stresses of alternating gluts and shortages. It is equally obvious that this cannot be done except internationally, and this inevitably means that it must be done at government level. The tragedy of the situation is that there are not at present the remotest indications that such a development is at all likely.

Even when commercial stock positions are reported accurately and promptly we are still left with the problem of government stockpiles. Substantially this means American Government stockpiles, as even in the case of tin, the stocks held by the buffer stock manager are considerably under one-tenth of the size of the American strategic stockpile for this metal. These large agglomerations, the accumulation of which has done so much to throw out of gear the tempo of the mining industry's natural growth, present no immediate market problem in that they are isolated from the market until such time as Congress may enact otherwise. Nevertheless, for the strategic purposes for which they were originally built up they are now to a considerable extent redundant, while in so far as they have been acquired as part of a domestic price support programme they are in any case superfluous. Sooner or later, therefore, we must expect to see them liquidated.

The timing of such liquidation is however going to call for statemanship of a high order. If this is not forthcoming, the eventual impact on world markets could be utterly disastrous. If they are used with understanding, and, moreover, if the statistical equipment to make this possible is by then available, they could well prove a tremendous blessing. It is apparent that in the long term the majority of metals are going to be in short supply at any rate within the price ranges with which we have been familiar and at which the stockpiles have been acquired, and it might well be that the worst consequences of these shortages could be mitigated by the timely use of these metal hoards.

In any consideration of prospective shortages in the long term, we have to consider the consequences alike for producer and consumer countries. Very broadly, the more highly industrialized areas of the world are dependent on mineral imports to sustain full industrial activity, while the more economically backward areas are dependent on capital investment from the industrial areas to enable them to develop their mineral wealth. Thus the stimulus which is imparted to the economies of such countries as Malaya, Northern Rhodesia or Bolivia by North America's fast growing appetite for imported minerals well illustrates this inter-relationship. It also serves to emphasize the catastrophic effect which wide fluctuations in metal prices can have for the primary producing areas. The United States can go on generating aid programmes for the underdeveloped countries with or without political strings till the (maybe imminent) crack of doom, but it will avail us all nothing if periodically the economies of these countries are to be put through the wringer as the result of some precipitous fall in commodity prices.

The certainty that the recession at present being experienced by the mining industry is no more than a pause in a tremendous long term expansion, has an especial significance for the British Commonwealth, as it is from the territories within this alliance that the greatest contribution could come within the next 25 years towards meeting the growing demand for metals. The implications of this prospect in terms of economic prosperity for some of the newer members of the Commonwealth, no less than for our remaining colonies, need no underlining. Such a development would alone be enough to set sterling's balance of payments problem to rights. However, expansion of the magnitude likely to be required is not just going to happen. It has got to be encouraged and facilitated. The initiative in this must come from the government but we have yet to see signs of any serious attempt being made, either by the British Government or by Commonwealth governments in concert, to formulate any long term Commonwealth minerals' policy, or even to establish adequate fact finding machinery to permit of policy making.

It is the prospect of eventual mineral shortage which explains why, despite the current recession, mining companies everywhere are still pushing ahead with their long-term projects for mineral exploration. although once the initial prospecting and preliminary planning of new projects are completed, their rate of implementation will, of course, be determined by the shorter-term prospect.

Even when we come to the mining and extractive processes, the problems of the industry remain substantially the same in slump as in boom. The challenge is that of achieving ever lower unit costs. More efficient methods and machines do not necessarily involve making greater demands on the skill of the individual miner, and indeed, as in other industries, the trend towards greater mechanization need not result in the employment of any greater skill on the actual process although calling for higher competence in the pre-planning and supervision of work and in the maintenance services. This point is of particular significance in some of the underdeveloped areas of the world where the belief that it is uneconomic to invest in complicated machinery if it is to be operated by semi-skilled native labour is being widely disproved.

To a considerable extent the successful introduction of more highly mechanized methods is a function of management as much as of technical skill and it is interesting to observe the extent to which in recent years the management consultant has been increasingly in demand in the mining industry in various parts of Africa, bringing with him from the factory more highly developed techniques of planning and control, of work measurement and costing.

Today the challenge to achieve lower costs may arise from the need to keep a marginal property in profitable production but tomorrow the purpose will be to bring within the area of payability grades of ore hitherto thought to be unworkable. In this context the comfortable philosophy that sufficient metals will in the long run become available by the natural economic process of pricing sub-marginal ground into the market carries with it the danger that too little attention will be given to expanding reserves by more efficient, lower cost, operation.

If indeed, this attitude still exists in the industry, it is a criticism not so much of the mine manager and his staff, who can do no more than maximize the efficiency of their available resources, but rather of those both in government and in the most senior ranks of the industry who have it in their power to stimulate the long-term fundamental research necessary to achieve the more revolutionary technological advances which alone can make major inroads on costs.

As usual it is a choice of priorities. Should our efforts primarily be directed to tuning up our existing mining and extractive processes, or should we be freeing more of our engineers to re-think and re-plan. Beyond a point we cannot do both together if only because of the shortage of top calibre mining and metallurgical engineers, which can only be gradually corrected as long-term recruitment programmes begin to pay off.

Nevertheless, higher productivity and lower costs remain the fundamental challenge, and the one consolation in the mining industry's present state of over expansion is that the unceasing demands on its skilled personnel for more and more production may for the moment be relaxed, so that some of these men may be spared for long-range planning and experiment.

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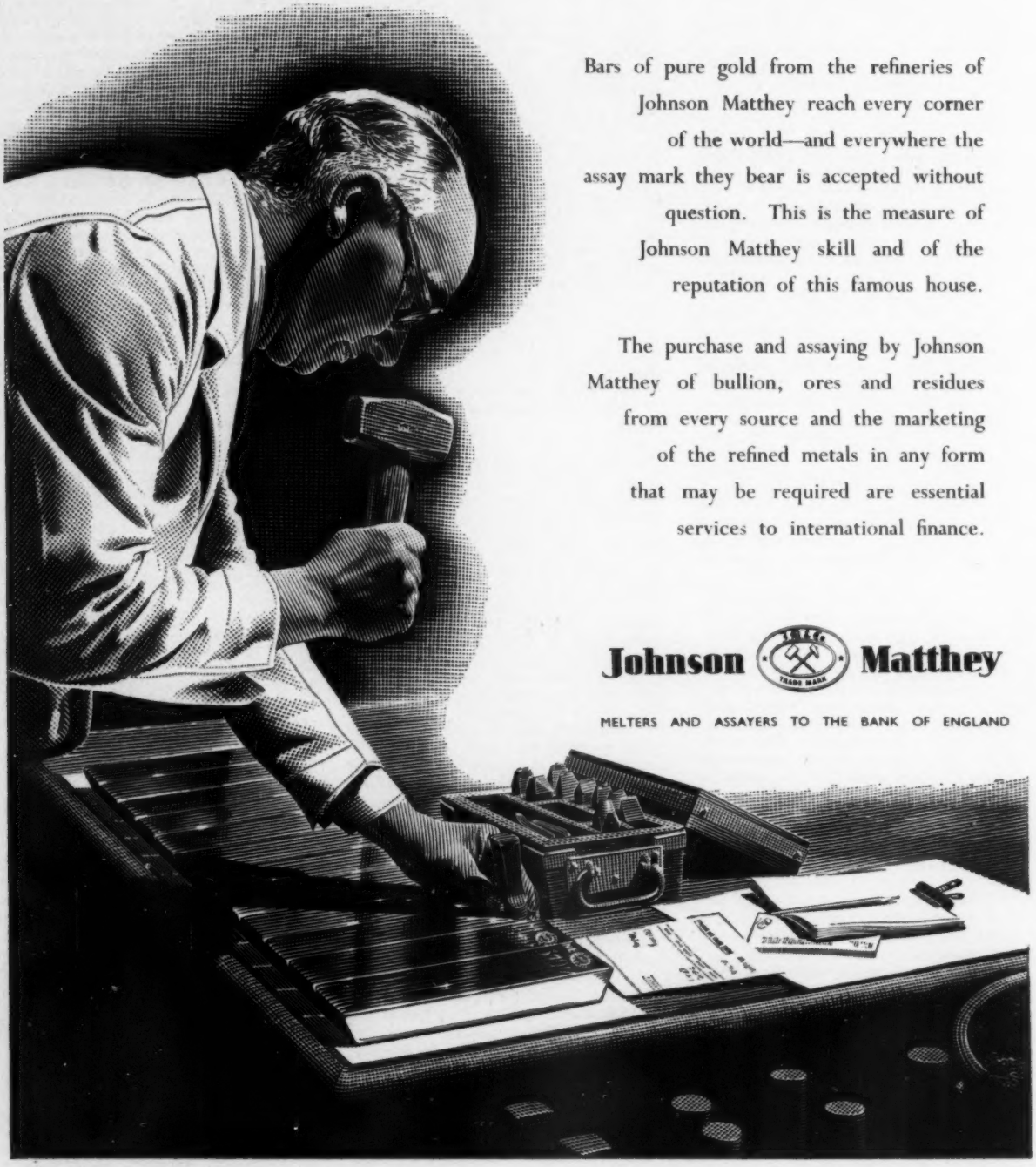

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The Precious Metals

GOLD • SILVER • THE PLATINUM METALS

GOLD *By R. Bruce Dunfield*

GOLD, its price distribution, and production, came under scrutiny in 1957 in a manner unknown since the early 1930's. No one *cause célèbre* can be relied upon to explain this massive change in thinking. But, in general terms, it may be said that the deterioration in economic conditions as reflected by the balance of payments difficulties in Europe and by the recession in America has concentrated attention on the case for a rise in the price of gold as a practical and effective means of restoring general business confidence and smoothing the flow of international trade and payments.

However welcome the prospects may be of the price of gold being raised to more realistic levels, turnover and price fluctuations on the free gold markets last year gave no indication that such an event was even remotely likely. Nevertheless, turnover in gold markets did increase and it is estimated that London, the centre of the world trade in gold, increased its turnover by at least 25 per cent. Central Banks, excluding the Bank of England, accounted for over half of the total turnover. The Bank of England, which handles the sale of South African gold, remained the largest single operator.

The pattern of trading behaviour followed the same course as in the previous year and the price of gold in terms of U.S. dollars tended to rise in the first half of the month on buying by Central Banks, who were debtors in the European Payments Union, and fall in the second half of the month. As in former years, most of these transactions were concluded outside the daily 'fixing.' Price movements at the daily 'fixing' were small. The highest price for 1957 was 251s. 5½d. recorded on August 2 and August 6 and the lowest 248s. 11d. on January 22. This represents a range of fractionally over 1 per cent and was primarily the result of fluctuations in the Sterling/Dollar exchange rate. These price changes were of minor importance as were those in the U.S. dollar which ranged from a low point of $34.84\frac{1}{4}$ reached on January 21 to slightly over $35.00 attained in August, October and at the end of the year, the difference between the high and low points being only about 17 c per oz.

In the past the international free gold market was regarded as a reasonably reliable barometer of world political and economic conditions as, indeed, the fluctuations of approximately $12.00 per oz. in 1949 and $6.00 per oz. in 1951 testify. Since the reopening of the London gold market in 1954, however, fluctuations have been rigidly limited and the range of quotations in 1956 (the year the Suez Canal was nationalized) was only 23 c. per oz., which compared with a spread of 11 c. per oz. in 1955. The use Central Banks make of the London market as a medium for their arbitrage operations in bar gold, and the fact that the Bank of England is ever ready to supply the market as a seller of newly-mined gold, exerts a highly stabilizing effect on the gold price.

Gold coins, therefore, are the only free market expression of the demand for gold to reflect important changes in the world's political and economic conditions. Even so, the premiums paid over the actual gold content of the coin in times of crises can at best be only a rough guide, since there are usually special factors operating on either the supply or the demand side of this market. A special example of this has been the recent minting of about 2,000,000 sovereigns at the Royal Mint, which are now being sold to authorized dealers in the bullion market at a price of around $9.25 per sovereign. This is the equivalent to selling gold at $39.00 per oz. and, after allowing for seignorage, gives a profit of about 11 per cent. Before the sales started this year the premium on sovereigns in the U.K. was about 16 per cent, so that the additional supplies have brought down the price quickly.

In 1957 the chief gold coins in circulation—Sovereign, Napoleon, $20 gold piece, Union Latine and the 20 Mark—all rose substantially above the value of their gold content. This was particularly true of the Napoleon, the premium paid on which in August before the *de facto* devaluation of the French franc on August 10 was 34 per cent above the value of its gold content.

That the Bank of England is able to act as a seller of gold on the market arises from its receipt of the newly-mined gold from South Africa, Ghana, Rhodesia, and certain other non-sterling area sources. Supplies from South Africa are the most important, but in recent years offerings of gold from Russia have been large enough to affect the market. Gold from the U.S.S.R. last year reached the unprecedented level of 7,500,000 oz., compared with 4,300,000 oz. in 1956. It is presumed that the heavy sales were made in order to clear balance of payments difficulties of the U.S.S.R. and of those countries which are economically dependent upon her.

The sale of such a relatively large amount of gold in one year has naturally raised afresh the query as to how much gold the Soviet Union produces per annum. Official figures are not released and estimates vary from 2,000,000 oz. to 9,000,000 oz. This latter figure is given as the estimate for 1953, 1954 and 1955 in the Annual Report of the Director of the U.S. Mint. Samuel Montagu & Co. Ltd. in their 1957 *Bullion Review* refer to "latest estimates of U.S.S.R. gold production which put it as high as 17,000,000 oz." with which reckoning the company more or less agrees. In the absence of any reliable data on this subject it is useless to argue the point.

In any event, there is no guesswork about how much gold South Africa produced in 1957; the output of 17,031,690 oz. compares with 15,892,935 oz. in 1956 and was an all-time record. South Africa's increased production was sufficient to offset lower output elsewhere, with the result that world production once again showed a marked increase. Canada's production showed a small rise over the previous two years, but because of the premium on the Canadian dollar in relation to the U.S. dollar, which adversely affected the price received for gold, the value of the total production was slightly less than the figure recorded for the preceding year.

In fact, the average price received for gold in 1957 fell to $33.55 per oz. compared with $34.45 in 1956 and $34.52 in 1955 and accordingly the value of the total production at $148,786,827 was less than in 1956, when it was worth $151,024,080. U.S. output was lower owing to the closing down of several lode mines, the curtailing of certain gold dredging operations and the cut-backs in production at some base metal mines producing gold as a by-product. However, Ghana made a better showing, indicating that the capital expenditure programmes put in hand a few years ago are now bearing fruit.

The outlook for the gold mining industry is better than it has been for many years. In times of falling prices and rising unemployment, it is, of course, only natural that the cost position would benefit. Yet allowing for the traditional situation of gold mines thriving in times of depression, the real force of this comment arises from the growing adoption in the industry of cost control procedures, the more efficient employment of the labour supply, increased mechanization and the utilization, wherever possible, of mechanical devices. These factors making for relief *in* the job are more than matched by excellent living conditions and social amenities providing relief *from* the job, which have also played their part in keeping down the turnover in the labour force. Nor must it be forgotten that changes are constantly being made in the treatment

WORLD GOLD PRODUCTION
Excluding U.S.S.R.
(In thousands of f.oz.)

	1955	1956	1957
Union of S. Africa	14,601	15,890	**17,032**
Canada	4,542	4,396	**4,419**
U.S.A.	1,877	1,865	**1,817**
Australia	1,049	1,030	**1,084**
Ghana	687	638	**790**
Southern Rhodesia	525	536	**535**
Philippines	416	406	**400***
Mexico	379	347	**350***
Colombia	381	438	**330***
Congo	370	374	**380***
Japan	289	295	**303**
India	211	209	**180**
Elsewhere	1,797	1,676	**1,680**
World Total	27,124	28,100	**29,300***

*Estimated (Source Union Corporation)

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of gold and continuous production by ion exchange methods may well revolutionize production costs.

As to whether the gold price will be raised in the near future, the answer would seem to depend on confidence in the continued prosperity of the American economy and in the U.S. Government's determination and ability to pursue policies, both externally and internally, which will maintain that confidence. While the international free gold market has failed to register important changes in the world's political and economic position, the interesting situation has arisen that the price of gold on the London market has been maintained well above the U.S. parity price of $35.00 per oz. Last month the quotation stood at $35.11-$35.13 per oz., its highest since the market was re-opened in March, 1954.

The basic reason is that supplies of gold on the London market have been reduced appreciably since the beginning of the year. Russian offerings have dried up, South African supplies have been cut to a trickle, and activities of the Central Banks have been virtually at a standstill. Why this situation has developed arises from the changing relationship between gold and dollars held as monetary reserves by the Central Banks. For the past several months, with the American recession showing no sign of lifting, Central Banks have been switching out of dollars into gold. While this cannot be interpreted that the banks view the possibility of an upward change in the gold price as imminent, it does indicate that in times of difficult economic conditions more reliance is placed on gold than on dollars. The U.K. Treasury seems to share this view and the latest issue of *International Financial Statistics* suggests that of the U.K's total reserves of $1,890 million in September, 1957 as much as $1,700 million was in the form of gold.

SILVER *By R. Bruce Dunfield*

THE repayment of all but a small percentage of the U.S. wartime Lend-Lease loans and London's independence of dollar area supplies after April were the only two events of importance in otherwise featureless silver markets in 1957.

The silver borrowed amounted in all to 410,800,000 oz. and was to be repaid on an ounce-for-ounce basis by April 28, 1958. By the end of last year all the debtor countries (see *Mining Journal Annual Review* 1957), with the exception of Saudi Arabia and Ethiopia, had discharged their obligations either by the physical transference of the silver or by passing title to the U.S. Government for the required number of ounces outstanding. At the time of writing, it is not known what plans Saudi Arabia and Ethiopia have in mind for funding their debts of 22,347,431 oz. and 5,425,000 oz. respectively. Under the terms of the original lend-lease agreement both countries were granted an extension of two years for their repayments.

That silver alone of all the commodities advanced under the lend-lease arrangements has been repaid in kind was due to the insistence of the so-called 'silver bloc' of U.S. Senators, who argued on the theory that the physical return of the metal would exert a strong influence on the price and thereby redound to the general advantage of the producer. If, indeed, the U.K., India and Pakistan, who between them owed practically 75 per cent of the total loan, had entered the market for their silver, the U.S. Senators' theory might very well have become a fact. For as Samuel Montagu & Co. Ltd. point out in their *Annual Bullion Review*, such a market operation attempted in so short a time would have driven the price of silver to the point where existing silver coins would have been worth more than their face value and would have made demonetization inevitable. Faced with this possibility the U.K., India and Pakistan resorted to demonetization in the first place by issuing base metal coins and withdrawing existing silver coins for refining.

Apart from the fact that a very large potential off-take of silver has vanished from the world market, the completion of the repayments has uncovered a fresh source of silver supplies from the surplus demonetized coin. Last year, for example, the amount of silver from demonetized U.K. silver coin was about 12,000,000 oz. and it is estimated that a further 100,000,000 oz. are available from the same source.

In fact this new source of silver led to a basic change in the Bank of England's policy. Prior to the satisfaction of the U.K's obligation under the lend-lease scheme, the Bank of England's policy was to make short term loans to the market which had to be repaid in kind. In May, 1957, however, with the lend-lease repayment completed, the Bank changed its policy from being a lender to that of being an outright seller, thereby obviating the need to spend dollars for the purchase of silver. Another item of interest was that as from January 1, 1958, only bars assaying 999 fineness are considered as good delivery on the London Bullion Market, whereas previously bars assaying between 996 and 998 fineness were acceptable.

During the year price fluctuations were limited on both sides of the Atlantic. In New York the high for the year was 91⅜ c. effective at the beginning of the year and the low of 89⅛ c. was reached on December 17 last. In London the peak price of 80½d. was established on December 8 and the nadir was recorded on December 18. These London prices are equivalent to 93.69 c. and 90.14 c. respectively, the difference of the high in London compared with that in New York being represented by the premium obtained for exportable silver in New York during periods of shortage.

Silver returned last year under lend-lease was responsible for increasing the U.S. "free stocks" which ended the year some 40,000,000 oz. higher at 127,400,000 oz. Although consumption figures since the end of the war show that basic demand for silver for industrial and other commercial purposes is growing at a faster rate than the demand for new silver coinage is contracting U.S. "free stocks" are now large enough to deal with any foreseeable increase in demand for some years ahead. Moreover, since only a part of the lend-lease silver returned in 1956 has been credited and some received in 1957 has not yet been credited, the outlook is for these "free stocks" to rise over the short term whatever the demand may be.

In the absence of any radical change in the U.S. silver policies continued price stability lies ahead. Yet with U.K. official supplies now available for over the whole year, and the possibility that the stepped-up U.S. defence programme may not absorb sufficient silver to offset the probable decline in demand in durable consumer goods under present economic conditions, the average level of the silver price may well fall to its lowest level in recent years.

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Excluding U.S.S.R.
(in millions of f.oz.)

	1955	1956	1957
Mexico	45.0	43.1	**46.0**
U.S.A.	36.7	38.7	**37.5**
Canada	28.7	27.7	**24.2**
Peru	18.4	21.8	**23.0**
Australia	14.5	14.5	**15.0**

PLATINUM *By A Special Correspondent*

AS with a number of the more common non-ferrous metals, the year under review has been characterized by a marked change in the market situation for platinum. In this case, however, the down turn has been rather more pronounced, for two major reasons. This time last year the whole platinum position was largely coloured by the very considerable demands being made by the petroleum refiners, and by the expected continuation of this high level for at least some three or four years more. As is now well known, the high octane petrol interests have been successful not only in reducing the amount of platinum required in their catalyst—although this move is open to question in terms of efficiency—but also in prolonging the life of installed catalyst by improving the cleanliness of their feed stocks. This depressing market factor virtually coincided with a sharp increase in supply planned by the major producer, Rustenburg Platinum Mines, so that in effect the curves of demand and supply have crossed each other. For the first time in many years therefore platinum has been an easy market, and the effect has been marked, both on the price of the metal and on output.

Declines in Price

Until July, 1957, the price remained firm at £34 per oz. in the U.K., or $95 in the U.S.A. At the end of that month the price of Canadian metal was reduced to £31 ($87), but South African metal remained unchanged in price until it was brought into line early in October. During this time the price of Russian platinum on the free market had weakened steadily, and whereas it had formerly stood on many occasions somewhat higher than the official price, there now began to appear a differential of 10s. or 15s. an ounce below. These offerings continued, particularly on the continent, and in early December a further reduction in both Canadian and South African metal was announced, to £28 10s. 0d., or $80. Weakness in the situation was still apparent, and was increased by offerings of excess platinum

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no longer thought to be needed by the petroleum refiners, and in mid-February the official price was further reduced to £26 15s. 0d. or $75 per oz.

Cut-back in Production

In the meantime a severe cut-back in production had been announced by Rustenburg. On December 19 the company stated that, with the over-supply situation continuing and with supplies still coming forward from Russian sources, current sales were running at only 60 per cent of the 1956-57 level and it was proposed to reduce output correspondingly.

Further details of the proposed action emerged during the subsequent two or three months. Milling at the Union Section is being reduced to negligible proportions, while the newly completed addition to the milling plant at the Rustenburg section is not to be put into commission. Later estimates of demand were as low as 50 per cent of sales for the previous period, and this figure is now the production target for the current year. Any enhanced demand for platinum can readily be met, of course, from plant already in existence.

Reliable production figures are rarely obtainable in the platinum world, but it appears that something like 150,000 oz. of platinum itself will represent Rustenburg's output for the present financial year, with some 75,000 oz. of the other platinum metals.

On the Canadian front the output of platinum metals from the International Nickel Co.'s mines at Sudbury has remained steady, but in March it was announced that a cut of 10 per cent was to be effected in nickel production, with a corresponding reduction of course in the output of the platinum metals. It was further stated that another cut might be found necessary if conditions did not show a fairly speedy improvement, and towards the end of April a further similar reduction was announced.

Russian production remains as usual something of an enigma, but reliable estimates run to something like 200,000 oz. per year of platinum exported to the western world, with a similar quantity of palladium. A somewhat encouraging feature here is the increasing interest being displayed in Russian petroleum refining circles in high-octane petrol and the use of a platinum catalyst in its production.

Industrial Uses

It should be understood that the doldrums into which platinum has fallen since last mid-summer are due solely and wholly to the changed situation in the petroleum industry. The demand for platinum and its allied metals in fabricated form remains strong, and is in fact growing steadily in a number of directions, but this strength is of course greatly overshadowed by the diminution in the one major field. Both western producers are actively carrying out research and development work to expand existing applications as well as the development of new uses. Most of these activities centre upon the three principal characteristics of platinum which provide its potential usefulness—resistance to attack in electrochemical operations, freedom from oxidation at high temperatures, and catalytic activity. Other uses now opening up include a cobalt-platinum alloy of exceptionally high magnetic properties which seems likely to have a number of applications in instruments and electronics, and a range of high resistance alloys for use in polentiometers and transducers incorporated both in industrial equipment and in guided missiles.

It is likely that a trough has been reached in demand, and that some perceptible upward trend may well be near.

Other Platinium Metals

Naturally enough some corresponding weakness has been displayed in the prices of the other members of the platinum metals group during the year. Palladium, also a Russian export, which was selling at £8 per oz. in June last, was reduced to £7 5s. 0d. in January, and again to £6 15s. 0d. in April. The prices of rhodium, iridium, ruthenium and osmium have all been subject to much the same degree of depression, but official figures are not readily quoted and depend largely upon the nature and extent of an enquiry. These four metals are not apparently among the Soviet products on offer.

Palladium continues to be in fairly good demand, chiefly as a catalyst in the pharmaceutical industry, in the production of certain petrochemicals, and in the purification of industrial gases. The take-up of rhodium in the form of electrodeposited coatings in the electronic industry continues, but its larger uses are those in which it is alloyed with platinum for the manufacture of catalyst gauzes for nitric acid production, for thermocouples and for use in the handling of molten glass.

An interesting and growing use of iridium is in radiography, where the radioactive isotope iridium 192 is finding extensive applications as the source of gamma-rays for the examination of castings, welds and other fabricated structures.

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By Our Metal Exchange Correspondent

THE year 1957 was one which presented the metal trade with many problems, as production continued to grow rapidly against a background of a slightly increased consumption outside America which, however, was outweighed by a decrease in that country. Prices continued the decline which started in the Spring of 1956 and contrary to most people's expectations there was no recovery during the year, and it was not until the first quarter of this year that there were some slight indications that the decline had been arrested.

On the London Metal Exchange itself, turnovers showed a tendency to increase, and the daily fluctuations, although still larger than many would wish for, were considerably damped down from those of the previous year. During the year, the Exchange once more began to operate as a medium through which excess stocks were financed and this is shown by the rise in the copper stocks from slightly over 4,000 tons at the beginning of January 1957 to 20,000 tons by the end of the year. As is to be expected under such circumstances, a contango has been maintained, although from time to time technical considerations have made it smaller than would be expected if based on purely financial considerations. This pattern has also removed the cost which was involved in hedging operations against stocks when a backwardation existed, and many more firms are now availing themselves of this facility.

In the tin market, stocks have risen from about 850 tons at the beginning of the year to 12,000 tons at the end of the year and 18,000 tons by the end of the first quarter of this year, but in this case the tonnage is due to the operations of the Buffer Stock Manager on behalf of the International Tin Council and at the present time only a very negligible tonnage is being financed by the market. In lead and zinc, the stocks still remain uncomfortably low owing to the continued activities of the U.S. Stockpile authorities during 1957. These activities are now ceasing, and the second half of this year should witness a welcome increase.

De-Stocking Exceeds Expectations

The year has been remarkable for its freedom from strikes, both in the producing and consuming industries, and this has meant that the normal flow of metal should have been maintained from mine to factory. In fact, however, this has not occurred, and the production/consumption picture has been disturbed by the use of accumulated stocks which were built up by consumers prior to and during 1955 when everyone was talking in terms of scarcity of metals. This de-stocking was helped by the prevalent pessimistic outlook of the majority of dealers in the metal world and the tonnage of metal which must have been hidden away far exceeds any statistician's estimate.

Another result of this using of stocks by consumers has been to keep surplus metal in the hands of producers, and this fact will probably help to dampen down the turn in the market when it eventually comes. Another new feature in the metal picture has been the appearance of zinc, tin, and, to a smaller extent, lead from Russia and it is a matter of argument as to whether the flow will increase during this year. During 1957, enough of the first two metals came on the world market to have some influence on the general price structure.

Overhanging the metal situation throughout the year has been the general economic situation in America, but it is not within the scope of this article to elaborate on this theme. Sufficient to say that non-ferrous metals are used in practically every sphere of modern day existence and that therefore their prices are particularly sensitive to actual and forecast trends in general productivity. Fortunately for the trade as a whole, the situation outside the States has done much to cushion the depressing effects engendered by the situation in that country.

Copper Fall Intensified —

Considering the copper market by itself, the price fell steadily from £265 at the opening of the year to £185 at the close of the year, and a backwardation gave way to a contango in the face of steadily mounting stocks. There were three developments outside the immediate province of the London Metal Exchange which have affected the copper situation as reflected by the daily quotations. These were: the end of the R.S.T. fixed price policy; the probability of the U.S. import tariff becoming effective again on July 1, 1958, and the talk of the introduction of an even higher tariff of 4c. per lb. with a "peril" point of 30c. in place of the existing 24c. Finally, there was the general policy which has been adopted by most major producers to negotiate long-term contracts with as many consumers as possible. It is of interest to go into each of these factors in some detail and ascertain the effect which it had on the market.

— By Price Fixing

The R.S.T. fixed price policy was adopted in May 1955 with a view to lightening the difficulties caused to consumers in the United Kingdom by the daily fluctuating price on the London Metal Exchange, and to this end, prices were originally quoted subject to 28 days' notice. It was soon found impossible to adhere to these 28 days, however, and by the autumn of 1955 each new price was subject to change at 24 hours' notice, which state of affairs continued until the scheme was withdrawn, the price being altered every time the span between it and the London Metal Exchange quotations became too great. The scheme was conceived in a time of potential shortage and rising prices and as long as these conditions lasted, the R.S.T. price lagged behind the open market quotations and for a time was of the greatest advantage to those U.K. consumers who obtain the majority of their supplies from the R.S.T.

However, after the turn of the market in the Spring of 1956, the "fixed" quotation lagged behind the fall in the L.M.E. quotations and could have caused serious disadvantage to U.K. consumers had the latter not made use of the Exchange for hedging sales. It was this very active hedging which helped the decline in the price. What occurred was that as soon as it became obvious the R.S.T. quotation would have to be reduced, consumers sold forward on the Exchange and waited to price in their physical metal until after the next reduction in the fixed price.

In theory, the consequent re-purchasing by consumers should have steadied the market, but sentiment was so "bearish" that any reduction in the fixed price was taken to be a sign of further weakness in the whole price structure and usually more sellers appeared than were necessary to supply the metal required by the consumers covering back their hedging sales. This effect of having a "fixed" price was eventually realized and the policy was revoked early in October 1957, when the R.S.T. resumed making sales on basis of the L.M.E. quotation.

— By Tariff Talks

The second development, which affected the lead and zinc prices besides those in copper, was the demand in America for additional protection against imports of virgin metal and semi-manufactured products. It became apparent during the last quarter of the year that the political atmosphere in Washington made it reasonably certain

that no further suspension of the duty was likely and therefore as from July 1 a duty of 1.7c. per lb. would become effective. As mentioned earlier, there is also an agitation for an even higher duty, but there are two schools of thought on the possible effect any duty will have.

Those in America in favour of duties claim that they will enable the American domestic quotation to be raised, which will give relief to the high cost producers in their country, and also to copper fabricators who are suffering from the competition of imported semi-manufactured items. The opposition school contends that since the United States is a large net importer of copper, the price in the rest of the world will have to be at a level to enable sales to be made to America, and that the inflow of foreign metal to that country will continue with the probable result that the price levels of to-day will not be improved upon.

The initial impact on the London Metal Exchange of the realization of the virtual inevitability of a U.S. tariff was for the price to fall to such an extent as to permit the shipment of metal to the States, even if the lower rate of tariff was applied. This tendency in London caused the whole world price level to be lowered, and the flow of metal to the States continued. It was just before this point was reached that producers realized that the only method of helping the price back to higher levels was to introduce cutbacks in production, but it was not until the first quarter of this year that the various actions taken stemmed the downward trend.

— By Unreal Long-term Contracts

The third development was the campaign undertaken by producers to fix up long-term contracts with consumers throughout the world, as they wished to be able to say that they had sold the major portion of their 1958 output, so as to strengthen their bargaining position when the question of cutbacks arose. This policy had a disastrous effect on prices, as the expected increase in consumption did not materialize and many consumers found that they had overbought and commenced to make hedging sales on the London Metal Exchange, in a number of cases even delivering physical metal.

The reverse of the picture was seen in the first quarter of this year when with only a slight increase in consumption, many European consumers who had made hedging sales and drawn off their stocks became buyers, and since producers had no free metal available at the prevailing price, excessive premiums had to be paid for the small tonnage of cathodes and wire bars available. If this phase continues, it is expected that the London price will have to rise in relation to the U.S. prices to a level to permit shipments to be made from that country.

All three of the above-mentioned happenings add strength to the argument that if proper use was made of the London Metal Exchange, the more violent fluctuations which have occurred recently would be eliminated, and it is the view of prominent members of the Exchange that if producers and consumers would be content to fix up 70 per cent of their estimated annual turnover in copper on long term contracts, with the balance of 30 per cent being put through the market, this would be sufficient to ensure that the daily quotations would be more solidly based than is sometimes the case at the moment, and the daily fluctuations would be greatly minimized.

There has been one further development in the field of pricing copper which, however, has not yet had any effect on the copper market in London. This is the attempt to establish an equivalent of the American *E. & M.J.* quotation. Late in 1957 there were conversations between the majority of producers supplying copper to the British and European markets, and it was decided that an approach should be made to the *Metal Bulletin* to publish a daily weighted average of all sales of electro copper made to these markets, based on reports given by the Rhodesian, Belgian and American producers, together with some of the European smelters.

Since sales reported are predominantly on basis of L.M.E. quotations with a small leavening of sales of Belgian copper, quotations published so far move in strict conformity with the London prices. It has not yet become apparent to what use these quotations can be put since they are purely historical and suffer the additional inaccuracy of not including sales to Europe based on the other historical quotation—that published by the *E. & M.J.* It has also been made clear that since this European quotation is historical, no contracts based on it are to be reported, and the absurd situation could therefore arise that if at some future date all sales to Europe were based on this *Metal Bulletin* quotation, there would be no reports to make the quotation itself.

Will the Tin Agreement Work?

At the beginning of the year the tin market stood at about £780 per ton for cash. In March the International Tin Council altered the prices at which the Buffer Stock Manager could operate with a view to enabling him to purchase metal at the existing price, so as to have something in hand should there be a further runaway in the upward direction, and small purchases commenced on his behalf during the second quarter. From then on the price steadily declined until it was firmly established with a floor of £730 per ton by October. This fall was largely due to the withdrawal from the market of the American tin plate industry, except for routine purchases in Singapore and the utilization by it of stocks which, as in the case of the other metals, soon proved to be far greater than calculated.

During the last quarter it was estimated that the Buffer Stock Manager would have to purchase about 10,000 tons by the end of the year, this tonnage being approximately equal to the estimated surplus of production over consumption for the 12 months. By the middle of November, however, it became clear that a very much larger tonnage would be involved and in quick succession the International Tin Council had to call up both the second and third contributions to the scheme.

Eventually, early this year when it was estimated that the Pool's holding had almost reached the maximum figure of 23,000 tons, a further announcement was made that additional monies would be provided to bolster up the scheme, if necessary, but even this only gave a temporary respite, as by the end of the first quarter cash metal was still having to be purchased by the Buffer Stock Manager in reasonable tonnages.

There is no doubt that the whole tin scheme is now in jeopardy, since export quotas have been introduced which cut permissible exports by as much as 40 per cent and already some of the weaker producing countries are complaining that their economies are being dislocated. At the same time, consumption fails to show any improvement and some think that stocks still in consumers' hands are sufficient to enable them to do nothing more than make routine purchases until some upswing takes place in international trade in general. The crux of the matter is whether the steps already taken by the Tin Council will be sufficient to bring about a price rise to the £780 per ton mark early enough to enable increased exports to be made during the second half of the year, and whether sufficient metal can be sold at that price to give the Buffer Stock Manager enough cash to be able to support the market again when this becomes necessary.

The production/consumption picture for this metal is additionally complicated by exports of tin from Russia and China. Early this year the former country registered a brand of tin with the London Metal Exchange and it is believed physical deliveries are likely without much more delay, and when this channel of disposal is used, it is the Buffer Stock Manager who will probably have to be the buyer.

The tonnage of tin from China is unknown but it is generally believed that it does not reach four figures and over 50 per cent of the available metal for export has already been sold to Japan.

U.S. Policies Main Factor in Lead/Zinc

The lead and zinc markets have followed parallel courses, with a steady and gradual decline throughout the year, except for a sharp fall in May. The consumption picture has been similar to that for copper; namely, outside America consumption has held up, whilst inside the States, commercial consumption has considerably declined.

During the first part of the year the excess production was taken care of by purchases for the American stockpile and by a monthly intake by the G.S.A. under the price support policy, but by the Autumn, industrial demand had fallen, intakes into the stockpile had ceased (although the price support policy continued into the New Year), and it therefore became necessary for cuts to be made in production. This was done, very reluctantly in some cases, but to a sufficient extent to lessen the rate of decline in the price, and after the turn of the year the price level remained almost stable, although in the case of zinc the price still appears to be below the economic level of production for a number of major producers.

Another factor which has had an influence on the markets is the barter transactions which have been entered into by the American Department of Agriculture, whereby surplus farm produce

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was bartered against—amongst other things—lead and zinc. Although this was not a major factor in the case of the latter, it played a great part in sustaining the lead price at the end of the year, as a sizeable tonnage was purchased through the medium of the Metal Exchange and this resulted in an almost complete exhaustion of physical stocks in the United Kingdom in the hands of members of the Exchange, and the appearance of a backwardation.

The other remaining factor of any importance has been the increased pressure brought to bear on the American Government to raise the tariffs on the two metals. Although a Commission was appointed and hearings took place at the end of 1957, no recommendations had been made to the President by the end of the first quarter of this year. In the meantime, however, sterling prices had declined to offset any possible increase in the duty, and as at the lower level there was little incentive for hedging operations to be undertaken on the London Metal Exchange, turnover in the two markets declined.

The outlook for 1958 remains very uncertain, but from the steps which have already been taken it would appear that producers are hoping that the prices will be forced upwards by about £10 per ton, even if general industrial activity throughout the world only maintains the 1957 level. It is probable that their calculations are reasonably accurate, since no new mines have been opened up or are likely to be opened and the consumption can be gauged fairly accurately on the basis of the last few years.

Functions of the L.M.E.

On looking back over the year, it becomes apparent once more that the London Metal Exchange still has much to do in the way of educating all branches of the trade on its correct functions and use, and this will become even more imperative should the European Free Trade area develop, as anticipated in some quarters. Some criticism has also been levelled against the Exchange on the grounds of conservatism, but when examined in detail, a number of the proposals, the turning down of which have given rise to criticism, were based on circumstances which had to be regarded as being temporary. It should be emphasized that the old and tried methods must remain the basis of dealings until it can be shown that long-term requirements necessitate alterations, for it will be readily appreciated that it would be quite impracticable to change continually the basis of the standard contracts currently in use.

The functions of the Exchange remain the same as they have done since it became an international market. These are that it provides a market where buyers and sellers can always operate in any tonnage of metal they wish; it provides a possibility of hedging against major price movements which can only be provided by the use of standard contracts in view of the enormous variety of purities and shapes, etc. in which present-day metals are traded; it provides also a method whereby surplus stocks of metal in the world can be financed by other than those directly connected with the industry; and, finally, it establishes and publishes quotations which, intelligently interpreted, give an indication of the general long-term trend in metal prices.

The Exchange remains the focal point of world dealings in copper, tin, lead and zinc and its prices are one of the main factors considered throughout all the industries in any way connected with these four metals. It can become of greater value to those making use of its quotations as pricing media if they themselves operate more on the market. It cannot be emphasized too often that the dealers on the London Metal Exchange do not make the quoted prices since these are the result of the execution of orders originating from all quarters of the globe. The greater the volume of these dealings the truer will be the result and the less the daily fluctuations which can be unduly influenced by very few sizeable orders in a market with only a small turnover.

COPPER *By Ursel Baliol Scott*

DURING 1957 the interest in copper has been centred on its price. The Free World's productive potential expanded considerably during the year, reflecting the culmination of new projects conceived as a result of the shortages of the post-Korean period. By and large, consumption was as good or better than might have been expected, while production cuts and deferred expansions resulted in Free World output being at least 150,000 tons below the figure originally planned for the year. Even so, it was the producers' inability to turn off the tap quickly enough, which resulted in stocks continuing to grow, and consequently in prices being progressively throughout the year brought down to lower levels.

Prices Trend Steadily Down

The beginning of 1957 found copper in about the middle of a downward price trend which started in the spring of 1956. Price relationships at the beginning of the year were typical of the pattern throughout 1957. The U.S. producers' price at 36 c. was about £20 ahead of the L.M.E. price, with U.S. custom smelters 1 c. below the producers' price and American export and dealer quotations a further 1 c. below that. The trend was steadily downwards throughout 1957 and into the New Year, so that by March 1958 there had been a steady fall for two years.

A graph on this page shows the movement of the L.M.E. cash price throughout the year, related to the U.S. producers' domestic price. This latter was persistently above the world price, so that excess stocks gradually built up in America to the point where in March 1958 heavy stocks were overhanging the American market side by side with an apparent near shortage of spot metal in the U.K. and Europe.

During 1957 there were two fairly short periods of sharply falling prices separated by two longer periods during which sustained efforts were made by the big producers to hold the price level. The first of these latter occurred over about four months from late February. There is no doubt that during this time the producers made determined efforts to hold the 32 c. level, supporting the London market actively from late-April to end-May and it was only when it became apparent that the hoped for Autumn revival in the American economy was unlikely to materialize that we witnessed a major price slide which did not flatten out until September. Thereafter the L.M.E. price remained markedly uncertain and at levels very substantially below the U.S. producers' price of 27 c.

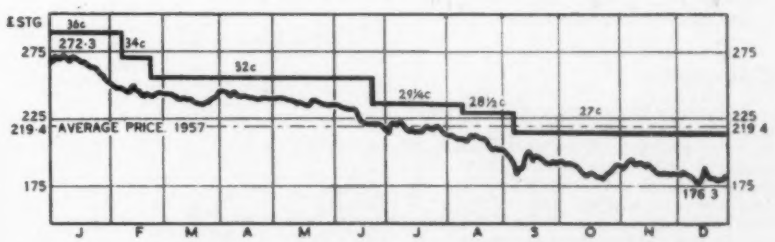
Should Cutbacks Have Been Bigger?

At the beginning of the year, forecasts of production for 1957 varied from 150,000 to 175,000 tons up on the 1956 total of 2,975,000 tons. (Long tons used throughout). In the event, however, 1957 production was no more than 3,000,000 tons. Cutbacks on capacity plus deferred expansions during the year (which was one not seriously effected by strikes) thus amounted to about 150,000 tons.

The table on page 14 shows the output of the principal Free World countries for the past three years together with the output, which at the beginning of the year it had been expected these countries would reach in 1957. From this, it will be apparent that the principal production cutbacks came from the U.S., Chile and Canada (each of which actually reduced output a little from the level of 1956), while production from Northern Rhodesia increased by about the amount forecast here a year ago.

Russian production, which in 1956 is believed to have been around 375,000 tons, is thought to have been only slightly higher in 1957. Certainly, Russia continued to be a substantial net importer of copper during the year.

It may be asked why, with stocks visibly rising throughout the year, production cuts were not introduced sooner



L.M.E. cash price of electro compared with U.S. producers' domestic price

MINE OUTPUT OF PRINCIPAL COUNTRIES
(in thousands of l.tons)

	1955	1956	1957 Planned*	1957 Actual
U.S.A.....	890	987	1,040	962
Chile	427	482	505	475
N. Rhodesia	353	398	430	429
Canada	291	317	340	309
Belgian Congo....	231	246	260	239

*Planned output for 1957 refers to output each country was originally expected to attain prior to introduction of cutbacks.

and on a greater scale. There were probably three considerations which influenced most of the major producers in varying degrees.

The first, which was largely psychological, was that the last time producers cut back (early in 1954) their miscalculation of the strength of European demand had had disastrous consequences, so that once the market began easing again in the second half of 1956, there was at first a general inclination to build up stocks so as to avert any future danger of yet another copper squeeze on users, who had already shown themselves fully alive to the scope of substitutes. Thus up to a point, stock building by producers was a matter of deliberate policy.

The second factor which delayed cutbacks, just about the time when stocks began to build up noticeably, was the hope that American industrial activity would stage a recovery in the autumn. Once it became apparent that the recovery was not going to eventuate, producers ceased to support the market and cutbacks became more general. Even so there was a certain amount of hesitation and jockeying for position at this stage due to Chile's desire to maximise revenue even at the cost of prices falling further, and it is arguable that the other big producers would have done better to cut back more sharply during the late summer and early autumn without ado.

A third factor in the situation, which may well, at this stage, have begun to make further cutbacks difficult, was that some Commonwealth and Chilean producers had so great a part of their output sold forward under long term contract, that it became impossible for them to cutback beyond a certain point without defaulting on their deliveries. It is probable, too, that few producers or consumers foresaw last autumn the extent of the American slump. The fact that consumers, who did not always require the large deliveries they were receiving, dumped their surplus copper back on the world market, is a consequence of the present day addiction to long-term contracts which our L.M.E. correspondent discusses elsewhere (see page 11). He also discusses the U.S. copper tariff, which must be an important factor in the calculations of U.S. producers.

Consumption

Estimates for the consumption of newly mined copper must, at best, be approximations owing to the considerable tonnages of scrap metal which always constitute part of the refinery production. Moreover, in making such estimates a clear distinction must be made between offtake by fabricators and actual consumption. Recent events have shown the importance of this.

Thus, while refiners' stocks in the U.S. did not begin to rise significantly until the mid-1956, fabricators' stocks of refined rose by about 100,000 tons between mid-1955 and mid-1956. In such a period deliveries of refined to fabricators bear little relation to actual consumption. Indeed, in retrospect, it can now be seen that the supply of refined copper in fact began to exceed consumption (at any rate, in the U.S.) during the second half of 1955. Yet between October 1955 and March 1956 the L.M.E. copper price had to rise from £350 up to £435 per ton in order to attract enough copper to Europe. In consequence of this stocking up against the price trend, the copper market will long bear the scars of erosion by substitutes.

In this article we must, of necessity, concern ourselves primarily with the consumption of newly mined metal, but it is as well to bear in mind that, taking the Free World as a whole, approximately 500,000 tons of secondary copper were re-processed and delivered as refined metal in each of the past two years.

A year ago in this *Review* we estimated the consumption of new metal in the Free World at about 2,900,000 tons. Later figures suggest that this was a little on the high side and, in fact, the total was probably about 2,800,000 tons of which the U.S. accounted for 1,205,000 tons. Preliminary indications are that consumption of new metal in 1957 totalled about 2,775,000 and was thus very little down on 1956.

Significantly, this level was maintained despite a sharp fall off in North American offtake, which declined by about 185,000 tons. The U.S. with an offtake of 1,040,000 tons accounted for 165,000 tons of this decrease, due mainly to declines in the motor and building industries. This decline in North America was, however, largely offset by a net increase in consumption in the rest of the Free World of some 160,000 tons—a notable change from 1956 in which there had only been a very small increase in consumption outside of North America.

The apparent Free World surplus of production over consumption of new copper was thus about 175,000 tons in 1956 and 225,000 tons in 1957. Against this, Government stockpile operations on balance resulted in net offtakes of about 20,000 tons in 1956 and 60,000 tons in 1957. (The U.K. government offtake was somewhat larger in each of these years as the Board of Trade released 13,000 tons to the market in 1956 and 20,000 tons in 1957.) If we make the conventional assumption that the supply and consumption of copper scrap were in balance, and after adjusting for stockpile offtake, we get surplusses of 155,000 tons in 1956 and 165,000 tons in 1957, or a total of 320,000 tons over the two years.

Stocks

Statistics on copper stocks are always very incomplete and we can do no more than give in the table below estimates supplied to us by the *British Bureau of Non-Ferrous Metal Statistics*. These are exclusive of U.S. or U.K. stockpiles. The figures for the U.S. are accurate but those for the rest of the Free World may have some degree of error and should, therefore, be regarded as no more than a guide to probable order of magnitude. Stocks at the end of 1957 are compared with the position at the end of 1955 when prices were near the top.

On the basis of these figures total copper stocks in the States have increased by at least 200,000 tons over the past two years (equivalent to an approximate increase of from 13 to 22 weeks' requirements at current rates of consumption) while stocks in the rest of the Free World have risen by perhaps 215,000 tons (equivalent to an increase from 13 to 18 weeks' requirements).

While bearing in mind the tentative nature of these estimates, it is, however, possible to make certain deductions from them. In the first place, as consumers had already begun stocking up again (more especially in the U.S.) during the latter half of 1955 despite the steeply rising price of copper at that time, there seems no reason to think that stocks at the end of 1955 were unduly tight. Pipeline stocks in the U.S., because of the shorter distances involved, naturally need to be less than in the rest of the Free World and it may well be that over the past two years the increase in stocks outside of the U.S. has contributed more to smoother marketing (as reflected for example in the readier availability of copper on the L.M.E.) than to any excessive build-up of stocks. The growth of stocks in the U.S. in this period must, however, be regarded largely as surplus to requirements, perhaps to the full extent of the increase (200,000 tons).

On a world basis such an excess is not in itself an unduly alarming weight of metal. On the other hand, it is easy to underestimate the effect of small increases in stock on a world market dealing mainly in marginal supplies, especially when consumption is trending downwards. Moreover, it must be remembered that stocks have only been kept down to their present level by severe production cutbacks and the continuation of Ameri-

APPROXIMATE FREE WORLD COPPER STOCKS
(000's l.tons)

Location	*As at Dec. 31*	*BLISTER (incl. that in process of refining)*	*REFINED*			*TOTAL (Blister and refined)*
			TOTAL	*OF WHICH*		
				At refiners in transit	*At Consumers*	
Inside U.S.A.	1957	245	260	165	95	505
	1955	180	120	55	65	300
Outside U.S.A.	1957	210	525	300	225	735
	1955	160	360	185	175	520
Total	1957	455	785	465	320	1,240
	1955	340	480	240	240	820

can stockpile offtake. Consequently, with the economic recession in the States showing little signs of easing, the extent to which stocks may grow further in the U.S. during 1958 becomes a matter of very real concern. What is the outlook?

The Outlook Now

For the Free World as a whole, production cutbacks announced up to mid-March 1958, are equivalent to about 300,000 tons in a full year and amounted to about 105,000 tons in 1957. This year we might thus expect production to be down by up to 200,000 tons (making no allowance for production increases already planned which some operators may not be deferring). On the other hand, consumption in the U.S. alone might well be down by 100,000 tons and it has yet to be seen whether the improvement in European demand will be maintained. At best, therefore, we must, in the absence of further cutbacks, expect an excess in supply this year of at least 100,000 tons.

The stockpile offtake again assumes crucial importance. Allowing for the escalator clause in the U.S. government's long-term contracts with the San Manuel and White Pine Mines, it seems possible that the government stockpile offtake this year may total 90,000 tons,if— but only if —the domestic price does not exceed 27 c.

Failing a revival in consumption, U.S. producers are, on this showing, going to have to wait a long time for excess stocks to be run off, and it may well be that further production cutbacks will be inevitable. It should, however, be remembered that during 1956 and 1957 production losses from strikes were extremely small; he would be a rash man who would prophesy that there will be no major stoppages on the Copperbelt or in Chile.

—And in the Long Term

About the long term expansion in copper consumption, there can, however, be no doubt. Indeed it has been the very certainty of this trend, coupled with the inconveniences of the post-Korean shortages, which have led to the excess of mine capacity which we see today. With the United States consuming nearly six times as much copper per head of the population as the average for the whole of the Free World, the potential needs no stressing and it is scarcely surprising that copper demand from the countries outside North America's showing such strength.

This trend must surely continue. It is, however, a somewhat disconcerting tribute to the efficiency of substitutes that the growth of annual consumption of new copper in the States over the past seven years has been almost imperceptible (consumption *per capita* has actually declined), while in the rest of the Free World it advanced by over 650,000 tons.

Given a steady growth in consumption, the long term outlook for copper is healthier today than for many years past. For the first time since the war the industry has now got room for manoeuvre. Stocks are admittedly high but not yet embarrassingly so. In addition, the industry has much reserve productive capacity.

On the basis of present long range plans, and assuming a price level of 35 c. (which would render payable all the North American low grade mines which have been in operation in recent years), there is no reason why the Free World's productive capacity could not, if required, be 500,000 or 600,000 tons per annum higher by the end of 1961 than the actual level of production last year. Taken together, the level of stocks and reserve of capacity provide margin enough for ensuring the future availability of copper for all new and expanding uses, and consequently for ensuring that the copper price should not again go through the roof in the face of a sudden expansion in demand.

There remains the problem of the price at which ideally copper should be sold in the best interests both of the producer and the consumer. Among American producers, it is apparently widely felt today that 35 c. is the level at which to aim. On the one hand, this is high enough to ensure adequate capital growth within the industry, both for depreciation and for financing the development of new production to replace mines nearing exhaustion. On the other hand, it is felt that this price is low enough to ensure no further inroads into the market by substitutes.

Ceiling of 28½ c. for 1958?

There is, however, nothing in the immediate outlook to suggest that any increase is at all imminent. Indeed in the first three months of this year stocks at U.S. refiners have risen by a further 50,000 tons. Moreover, even if the U.S. producers' price did rise, it is difficult to see it at present going above 28½ c., as at this point the whole of the stockpile offtake would be back on the market. This must, therefore, be regarded as copper's ceiling—at any rate, during 1958.

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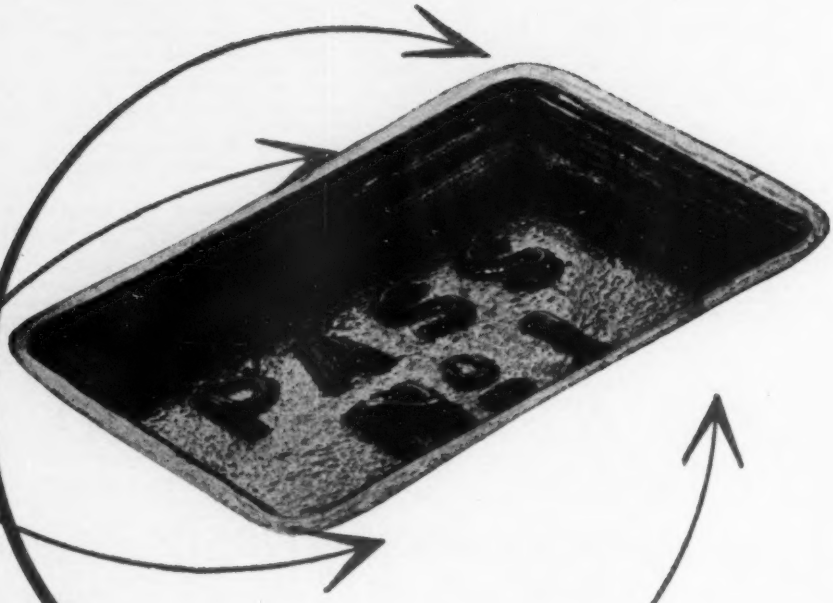

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TIN *By W. Fox*

THE world tin position looked sound until the middle and even into the third quarter of 1957. On the one hand, commercial consumption was moving upwards even beyond the high levels of 1956; on the other hand, mine production was moving downwards slightly. Production was still higher than consumption. The excess in the third quarter of the year was at the annual rate of under 10,000 tons, but this compared with an excess of over 15,000 tons for 1956 and seemed well within the capacity of the buffer stock operations of the International Tin Council.

In fact, however, the position had begun to change by the summer. U.S.A. consumption turned downwards in the second quarter of the year and in each quarter thereafter; consumption in the U.K. turned down in the third quarter; consumption in the rest of the world turned downwards in the fourth quarter. Supplies were augmented by imports from the U.S.S.R. which became substantial in and after the third quarter. In October, the London cash price fell to the floor £730 at which the buffer stock manager of the International Tin Council had to buy; and, with occasional exceptions, the price remained at or slightly above this floor until the end of 1957 and into the spring of 1958.

The Mine Position

Mine production showed few surprises. In Indonesia, the decline which had started in 1954 continued into 1957. Production in 1957 at 27,700 tons was 8 per cent below the 1956 level. This was not due primarily to political difficulties in Indonesia since the bulk of the fall took place early and not late in the year. The Congo production also continued to fall, but more gently. Malaya, whose rise had hitherto been unchecked, moved down in 1957 by 3,000 tons. Nigeria continued to rise steadily; Thailand continued to rise sharply. In the case of Bolivia the high level of production in the last quarter of the year managed to push up the total for 1957 so as to exceed both 1956 and 1955.

In total, world mine production, excluding the U.S.S.R., for 1957, was 173,500 l.tons against 175,500 tons in 1956. These totals include estimated production from China of 9,600 tons in 1957 and 8,400 tons in 1956.

The six producing countries participating in the International Tin Agreement produced 152,200 tons in 1957 (or 88 per cent of the total) as compared with 155,600 tons in 1956. Outside these six countries, the main features of importance were a nominal rise in the estimate for Chinese production; a slight rise in South-West Africa; a more substantial rise in Laos; a drop in Australia; and, so far as can be ascertained, a continued stagnation on a low level in Burma. No information was made available or can be reliably estimated as to the mine or metal production of the U.S.S.R.

The Smelter Position

In the smelting field, three events were important during the year. The first was the closing down in January of the U.S.A. government-owned Texas-City smelter. The second was the diversion to U.K. smelters of the bulk of that Bolivian material which Texas had been smelting; as a consequence, the output of the U.K. smelters in 1957 rose to over 34,000 tons. The third event brought Texas City back into the picture. In December, concentrates were shipped from Indonesia to the Wah Chang Co., the new owners of the Texas City smelter. The Indonesian position in early 1958 showed a sharp reduction in exports to the Netherlands; and it was reported that the position of the Arnhem smelter in the Netherlands, which had smelted the bulk of Indonesian concentrates for many years, was now in jeopardy.

The Down-turn in Consumption

The commercial consumption of tin metal had been rising since 1952. It reached a post-war annual peak in 1956 of 160,000 tons. It rose above this peak in the first half of 1957 and in the late summer was running at an annual level of nearly 164,000 tons. Only one country—the U.S.A.—did not share in this increase. There, monthly consumption began to lag from May onwards. The main check generally to consumption came in the period September-November. A comparison of consumption in the first quarter and in the last quarter of the year shows a decline of over one-quarter in the U.S.A., one-sixth in the U.K., but only a very small change elsewhere.

The down-turn in consumption reflected primarily—but not entirely—the movements of the tinplate industry which normally takes some 40 per cent of all the world's tin. World tinplate output, excluding the U.S.S.R., reached a yearly peak of nearly 7,500,000 tons in 1956 and some very optimistic estimates were made as to what was likely to happen in 1957. In fact, for the first half of that year production was at the annual rate of over 8,500,000 tons. The tide changed, however, in the U.S.A. abruptly in May. There was no real recovery there for the rest of the year.

WORLD TIN CONSUMPTION

1957:	*U.S.A.*	*U.K.*	*Rest of world, excluding U.S.S.R.*	*Total (in l.tons)*
First quarter	15,600	5,900	20,000	41,500
Second quarter	14,400	5,800	20,800	41,000
Third quarter	13,600	5,100	20,400	39,100
Fourth quarter	11,100	5,000	19,800	35,900
Totals, say	54,700	21,800	81,000	157,500

MINE PRODUCTION
(000's l.tons of tin metal)

	1955	1956	1957
Malaya	61.2	62.3	**59.3**
Indonesia	33.4	30.1	**27.7**
Bolivia	27.9	26.8	**28.0**
Belgian Congo	15.0	14.8	**14.3**
Thailand	11.0	12.5	**13.5**
Nigeria	8.2	9.2	**9.6**
Others (ex. China)	11.9	11.4	**11.5**
	168.6	167.1	**163.9**
China (est.)	8.4	8.4	**9.6**
Total	177.0	175.5	**173.5**
Total Consumption (ex. U.S.S.R.)	154.5	160.0	**157.4**

Production elsewhere was maintained at relatively high levels for some time, but Canadian output lagged from September, Japan from October and the U.K. from November. In spite, therefore, of the fact that the annual productions of Belgium, France, Italy, the U.K. and the Netherlands were higher in 1957 than in 1956, the overall world total for 1957 was slightly less than the 7,500,000 tons record of 1956.

The Trade in Russian Tin

In the post-war years the trade in tin with the U.S.S.R. and Eastern Europe had been a one-way trade; that is, exports from Malaya and Western Europe with no counterbalancing import. This export trade fell off in 1955-56; and during 1956 small tonnages from the U.S.S.R., Czechoslovakia, Poland and China appeared on the Western European market, either as direct import or by way of transit trade.

During 1957, and particularly in the later part of the year, this flow from the U.S.S.R. became substantial. In view of the sharp change in the consumption position at the same time, these Russian supplies had perhaps an unduly depressing effect on prices. Some 9,000 tons of tin from the U.S.S.R. and Eastern Europe were imported into Western Europe or moved in transit trade through the Netherlands to Western Europe during 1957. The main direct importers of U.S.S.R. tin were the Netherlands, the U.K. and Federal Germany. The main destinations of Russian tin in the transit trade were Denmark and Federal Germany. The trade was continued into 1958. Imports of Russian tin into the Netherlands during January-February, 1958 were relatively heavy; and in the same months imports into France were reported.

Do these exports from the U.S.S.R. represent merely temporary measures to provide the U.S.S.R. with currency? Do they indicate a long-term surplus of metal in the U.S.S.R. (whether smelted from Siberian or Uunnan concentrates)? Do they represent the release of strategic stockpiles, accumulated in part at least during the Korean crisis of 1950-51, which are no longer regarded as necessary? The answer to none of these questions is known.

The Buffer Stock

The Buffer Stock Manager of the International Tin Council had a quiet life in the first quarter of 1957; a reasonably busy one in the second and third quarters; and an extremely busy life in the fourth quarter.

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The first initial contribution, totalling the equivalent of 15,000 tons of tin, was paid up entirely in cash during the first half of the year. In March, the Council changed the floor price in the International Tin Agreement from £640 to £730, but left the ceiling price of £880 unchanged. Under the new price ranges in the Agreement (that is, £730 to £780, £780 to £830 and £830 to £880), the manager could buy in the first range if he felt it desirable to prevent the price falling too steeply. In April, the price was below £780. It continued to fall, cushioned however by the buffer stock buying. In October, it reached the floor price of £730 at which the buffer stock was compelled to support. The degree of activity of the buffer stock was indicated by the figures of tonnage held: Nil on March 31, 1957; 3,915 tons on June 30; 4,315 tons on September 30; 10,000 tons in late November; 15,000 tons in late December.

The first additional contribution of 5,000 tons was called up from the producing countries at the end of November and was promptly paid in cash; the second contribution of 5,000 tons was called up at the end of December and was fully paid also in cash. Further, at the meeting of the Council in January, 1958 the delegates of the producing countries agreed to recommend the creation of a special fund for the use of the Buffer Stock Manager.

Export Control

The purpose of the buffer stock is, however, merely to deal with short-term fluctuations. For the longer-term problems of disequilibrium between supply and demand, the International Tin Agreement provides the weapon of export control. In October, the Tin Council was anticipating a surplus for 1957 of 12,500 tons. No action on export control could be taken, however, since the buffer stock did not yet hold 10,000 tons of metal. By the Council's meeting in early December the anticipated surplus for 1957 had increased considerably whilst the overall consumption position was still worsening. Export control was, therefore, put into operation for the three months from mid-December, 1957 to mid-March, 1958 (later extended to the end of March). Export control was also operative for the quarter April 1-June 30, 1958. For both control periods the overall rate of reduction in the six participating producing countries concerned was about 40 per cent, although, of course, the incidence varied with the degree of restriction being particularly heavy in Thailand and also in Nigeria.

The effect of these steps by the Council was not fully felt in the spring of 1958. There was a substantial production in the immediate pre-control period which swelled the normal pipeline of the industry. It is probable, however, that the excess pipeline will be worked off by April-May and that the second period of export control (April-June) should see prices influenced. It is worth noting that, at the time export control was put into operation, the Council foresaw the possibility of a too rapid upward move in prices and therefore gave the Buffer Stock Manager the power to sell above £781 for the protection of consumers. The rapid accumulation of the buffer stock, the sharp application of export control and the imposition of what is in effect a new ceiling price in the export control periods, show that the International Tin Agreement possesses a high degree of flexibility.

LEAD *By J. A. Dunn*

THE year under review may well be regarded as one in which lead producers were brought back to earth; within a few brief days in May their years of easy affluence gave place to a period of grim marketing. Particularly amongst those who have entered the industry in recent years, 1957 provided an experience of price movements which will be of great value to their future judgment, for the lesson became only too clear that, no matter what Government actions may be taken to support prices, ultimately the relation of production to real consumption becomes the sole deciding factor. Indeed, price support policies which disturb the relation of supply to real consumption encourage normally uneconomic production, and lead eventually to a more severe collapse of prices than would otherwise have occurred.

Supply and Demand

World production early in the year continued at a high level, encouraged by the continuation of high prices. U.S. stockpiles continued to absorb surplus lead, and, in March, the first release of 3,000 tons* per month from the U.K. stockpile helped, if anything, to relieve the tight supply of

* Long tons used throughout

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MINE PRODUCTION

(000's long tons)

	1955	1956	1957
Australia	296	299	330
United States*	302	311	302
Mexico*	207	196	196
Canada*	173	167	162
Peru	114	127	135
Yugoslavia	89	86	85
French Morocco	88	85	84
South-West Africa	81	86	90
Germany (Fed. Rep.)	66	64	70
Spain	62	60	63
U.S.S.R. (est.)	290	305	305
Others (est.)	384	350	350
World Total (est.)	2,090	2,140	2,170

* Estimated Recoverable

prompt metal which had developed as a result of U.S. barter dealings.

Such official announcements as there had been at the end of 1956 had led most to assume that U.S. stockpile policies would be continued in 1957. However, it became increasingly obvious that the real statistical position of lead was steadily deteriorating as world consumption was not improving commensurately with production, and that the metal was entirely vulnerable to any change in U.S. stockpile policy. Although everyone appreciated that such change must be made ultimately, the official hints in April of a forthcoming change were made rather earlier than most had expected. Unfortunately, the time chosen for the change of policy coincided with a period of slackened industrial activity and of reduced lead consumption in the United States. Intake of lead ore, concentrates, and unrefined metal against agricultural barter transactions ceased in mid-year, and thereafter normal stockpile purchases (still around 5,000 tons a month) were insufficient to prevent accumulation of producer stocks.

The price climate, which had been so favourable to producers since 1954, rapidly deteriorated, the initial fall in May was precipitate, and over the latter half of the year producers were experiencing something of the same market conditions as ruled for a few months after the London Metal Exchange reopened in 1953. In later months the price level was not helped by the manoeuvres of U.S. high cost producers to increase the duty on imported metal. Late in the year the announcement by the U.K. Government that further metal would be released from the U.K. stockpile, even though reduced to 1,200 tons a month, could not perhaps have come at a more inopportune moment. Russian lead appearing on European markets has added to the surplus.

Many small marginal mines went out of production as the year progressed; nevertheless, because of the high production rate in the early months, the total for the year was apparently slightly ahead of the previous record in 1956. Production in the former leading producing country, United States, declined, and Australia moved clearly ahead to take the lead. The main producers in the Free World were: Australia, U.S.A., Mexico, and Canada.

In terms of smelter production, the Free World total of primary lead was apparently around 1,800,000 tons; including the Soviet sphere, the world total was some 2,100,000 tons.

Although consumption in most European countries was maintained in the early months at or above the 1956 level, consumption in the U.S. fell away with slackening in activity of the automobile industry. The total Free World consumption for the year appears to have been rather below that of 1956, perhaps a little above 1,600,000 tons of primary lead—of this, U.S. consumption was about 640,000 tons.

By and large it may be broadly stated that, whereas the prices through 1956 to May 1957 had been decidedly flattering to the fundamental statistical position, the prices in the latter half of the year went to the other extreme and broke through the floor of what might be regarded as the normal general price range for lead.

Main Countries

In the U.S., many smaller mines closed after the fall in lead prices, others curtailed production and in September mine output of lead was the lowest in nine years. Total mine production for the year was 302,000 tons (311,000 tons in 1956). Smelter production, including some secondary metal, was 540,000 tons (547,600 tons). With secondary metal at 435,000 tons (444,000 tons) and net refined lead imports 272,000 tons (229,000 tons), the total available lead for consumption and stockpile was 1,247,000 tons (1,220,000 tons). Despatches from primary producers to domestic consumers were 413,400 tons (468,600 tons), the lowest since 1949; the reduction to cable makers was particularly noticeable. Smelter stocks of refined lead increased considerably over the year, from 36,000 tons on January 1 to 81,800 tons at the end of December. Consumer stocks of lead in all forms were little changed over the year and at December 31st were 95,000 tons (94,600 tons).

In 1957, Australian production of lead in concentrates exceeded 300,000 tons for the first time. Refined lead was a little below the 1956 level at 192,363 tons (194,506 tons), but lead bullion for export was a record, 47,220 tons (41,658 tons). Consumption, as indicated by smelter sales, was 39,062 tons (37,748 tons). End of the year prices were practically down to the break-even prices for even the more profitable mines. Several small mines prepared to shut down, and curtailment of operating time was to be expected in 1958. Expansion programmes, where the capital cost is to be met from profits, will be deferred or spread over a longer period.

In Mexico, some of the more marginal small mines shut down towards the end of the year, but overall production for the year was little changed; smelter production was 178,000 tons. Canadian production continued the decline since the peak year 1954, and was around 162,000 tons. Smelter production was about 125,000 tons. Consumption was rather lower at about 60,000 tons. Exports of refined lead increased to 80,000 tons.

In the United Kingdom consumption was little affected by the oil shortage in the early part of the year, consequent on the Suez blockade, and, as the automobile industry became more active in later months, consumption over the year as a whole was well maintained at little below the 1956 level, and totalled 349,156 tons (357,794 tons). Smelter output of refined primary and secondary lead was 80,046 tons (84,145 tons) and primary metal imports were 168,754 tons (172,363 tons). Stocks at end of the year were 51,300 tons (39,400 tons).

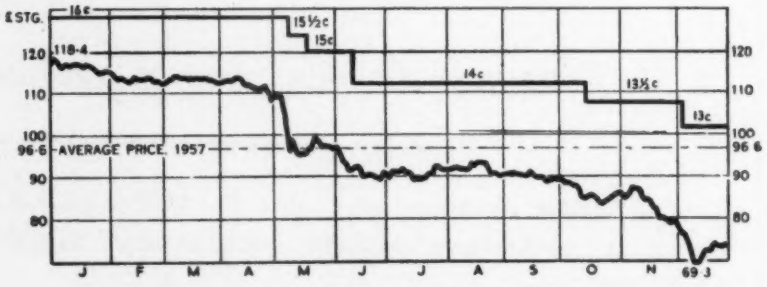
On the Continent consumption tended to fall away in the latter part of the year, but the overall consumption was little below that of 1956.

Outlook

Encouragement of development of lead-zinc ore-bodies, including some marginal production, by stockpiling in recent years has raised world total lead production capacity to a point considerably above the likely real demand over the next two or three years. It is unfortunate that changes in policy were made during a period when the rate of consumption increase flattened. However, there is the satisfaction of anticipating that the exploration and development undertaken during the period of high prices will show their real significance in the years ahead, when consumption resumes its upward trend.

In the meantime adjustment will come from the elimination of the more marginal mines and by cut-backs in production by the larger profitable producers. U.S. tariff increases can only worsen the position of lead mines in other countries by throwing the burden of oversupply more fully upon them. Such tariffs are critical only to that small proportion of U.S. producers which is marginal; U.S. consumers are unlikely to appreciate a tariff impost which, by its effect in raising the domestic price, provides an unnecessary benefit to the bulk of U.S. production. The only real solution is the improvement of world consumption, and this is not helped by making lead dearer in the country which is the world's largest consumer. As the evidence at the U.S. Tariff Commission hearings clearly summarized, the long-term position of the industry is not to be judged by the bottom-of-the-cycle conditions which are at present affecting producers in all countries alike.

The short term position would seem to be largely dependent on how soon industrial activity in U.S.A. will recover.



Lead (soft pig) price for current month on L.M.E. compared with New York price.

ZINC *By J. A. Dunn*

THE market position of zinc in 1957 continued to run parallel with that of lead. However, the announcements on U.S. stockpiling policies in April had caused a relatively greater price slide in zinc than in lead by June. The statistical position of zinc has been generally weaker than that of lead.

Supply and Demand

Early in the year, U.S. stockpiling purchases and barter deals against agricultural products continued to support production at the high level of 1956. Despite the severe falls in price from the end of April mine output of zinc was well-maintained in most countries, except in the U.S. and Canada where in the latter half of the year some small mines closed down and output from others was reduced. However, overall, the world total mine production of zinc was little different from that of 1956. The principal producing countries in the Free World continue to maintain the same order: U.S.A., Canada, Australia, and Mexico.

Smelter output also ceased its steep upward climb, and primary slab zinc production was of the order of 2,320,000 tons* in the Free World, or around 2,800,000 tons including Communist countries.

As the year progressed and consumption tended to ease further in the U.S., it became apparent in March that the continuation of stockpiling as a price support policy would require the absorption of increasingly large amounts of zinc into the various stockpiles. Thus the change in policy first announced in April was inevitable, but came rather earlier perhaps than most had expected a few months previously, particularly in view of the belief at the end of 1956 that stockpiling would continue during 1957. Some purchases of U.S. domestic zinc, as of lead, have continued to be made for the strategic stockpile, but they have been insufficient to prevent a large increase in commercial stocks. The release of 9,000 tons of zinc per quarter from the U.K. stockpile from September, although relatively small, increased the available surplus and worsened the statistical position. Over most of the year consumption was well maintained outside of America; towards the end of the year the only improvement in demand in America which was apparent seemed to be for high grade metal.

For the year as a whole, Free World consumption of slab zinc was of the order of 2,000,000 tons, rather less than in the previous year, because of reduced U.S. intake.

Main Producing Countries

In the U.S., mine and smelter production of zinc was running at a high level in the early months of 1957, and it was not until well into the second half of the year that the severe fall in prices began noticeably to affect production. Consumption, which in 1956 had fallen away from the peak of 1955, showed no sign of recovery, and continued its downward trend although imports of slab zinc and zinc in concentrates were the highest recorded. Smelter production from domestic and foreign ores was 883,000 tons (887,000 tons in 1956). Imports of slab zinc increased steeply to 240,000 tons (218,700 tons) largely due to barter stockpile intake, exports rising slightly to 13,400 tons (8,060 tons). Stocks of metal at metallurgical works increased consistently over the 12 months, and at December 31 stood at 148,800 tons (61,300 tons). Consumption of primary slab zinc was 836,000 tons (900,000 tons).

In Canada, slab zinc production declined further to 219,000 tons (228,000 tons). Consumption continued its down trend since 1955 and totalled 46,000 tons (53,000 tons).

MINE PRODUCTION
(000's l.tons)

	1955	1956	1957
United States*	460	484	460
Canada*	381	378	355
Australia	257	278	296
Mexico	265	245	240
Peru*	170	153	150
Poland	154	151	150
Germany (Fed. Rep.)	91	120	121
Japan	107	121	132
Italy	104	111	102
Spain	90	84	77
U.S.S.R. (est.)	255	270	270
Others (est.)	526	480	537
World Total (est.)	2,770	2,880	2,890

* Estimated recoverable.

* Long tons used throughout

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Australian production of refined zinc increased to 110,370 tons (103,247 tons) and represented the highest output to date. Domestic sales were 79,045 tons (69,912 tons), the main increase being in sheet galvanizing. Exports of concentrates increased to 140,000 tons recoverable metal (120,000 tons); mines associated with U.K. smelters tended to take advantage of reductions in freight rates to lower stocks at mines. However, concentrates generally intended for export are now being stockpiled pending an improvement in price.

Over the year, production of slab zinc in the U.K. fell away to 76,500 tons (81,470 tons). However, imports of metal increased to 147,841 tons (126,742 tons). Over the year as a whole consumption was maintained at a satisfactory level helped by the activity of the automobile industry; the total consumption of primary slab zinc for the year was 233,000 tons (228,634 tons).

In Western Germany recoverable mine production of zinc in concentrates (from pyrite and lead-zinc ores) was 121,000 tons, about the 1956 level. Production of slab zinc fell to 181,000 tons (187,000 tons), the fall being mainly in high purity metal. By and large consumption of slab zinc in Western Germany was fairly well maintained and increased slightly over the year. In general, production and consumption of slab zinc in other continental countries was well maintained in the first half of the year, but fell away in the second half. The full year's figures for consumption showed a slight increase over 1956.

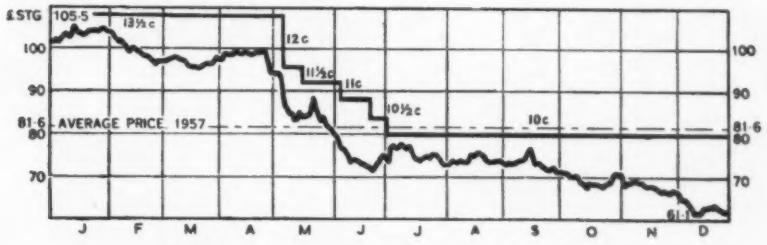
Outlook

The influence of U.S. stockpile purchases on zinc pricing has virtually disappeared, although whilst some 9,000 tons a month continues to enter the stockpile the statistical position of the metal is not quite as bad as it otherwise would be. The decision of the U.K. Government early in 1958 not to release further zinc from stockpile will at least not worsen the position.

Presumably the proposed U.S. tariff increase on zinc will be made. Maintaining, as it will, some marginal U.S. mines in production, the outlook for world production is made gloomier to that extent.

The origin of the present difficulties of zinc is, of course, the considerable impetus to production given by stockpile price support policies—the resulting increment in capacity has far exceeded the increment in consumption. Statistically, the day when the gap will close is not nearby. In addition, over the past year or so in particular, zinc has had a lot of competition from aluminium, consequent on the vigorous marketing policy of the main aluminium producers. From the price point of view zinc to-day is perhaps in a better competitive position than most metals, but competition is increasingly a matter of physical characteristics. In particular the die-casting industry is fully appreciative of this and there has been an improvement in zinc consumption for this purpose in recent months. That a vigorous marketing programme in the zinc industry, comparable with that for aluminium, is a decided requisite at this stage is well recognized.

However, the present period of reduced consumption follows from the general turn of the industrial cycle to reduced activity, especially in the United States, and in part from credit restrictions. When the cycle of consumption will resume its general upward trend is not easy to prophesy at present, but, should U.S. stockpile buying terminate, existing zinc production capacity is such that at any rate two or three years may elapse before the gap is fully closed, assuming the absence of abnormal factors. Ultimately, of course, the day will come when the exploration and development of zinc-bearing orebodies, undertaken when prices were high, will have their reward.



Zinc (G.O.B.) price for current month on L.M.E. compared with U.S. price East St. Louis.

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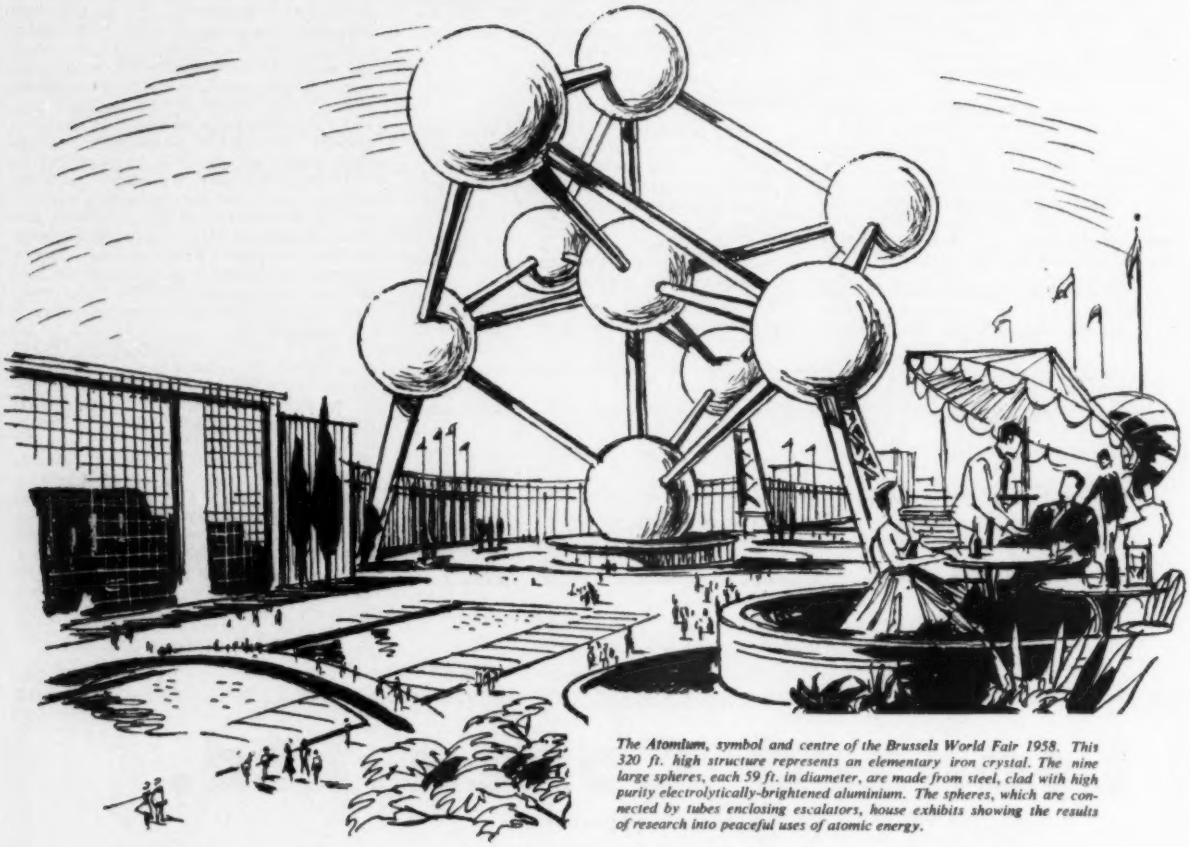

The Atomium, symbol and centre of the Brussels World Fair 1958. This 320 ft. high structure represents an elementary iron crystal. The nine large spheres, each 59 ft. in diameter, are made from steel, clad with high purity electrolytically-brightened aluminium. The spheres, which are connected by tubes enclosing escalators, house exhibits showing the results of research into peaceful uses of atomic energy.

Aluminium is once again proving itself to be the Metal of the Age in this era of scientific adventure. Architects and designers of many nations are using this strong, light, corrosion-resistant metal with imagination and ingenuity at the Brussels World Fair in the national pavilions and exhibition halls. Here are just a few examples:

CANADIAN PAVILION
Aluminium span windows, stairway and external doors.

BRITISH PAVILION
30 tons of NORAL aluminium used for the roof.

AMERICAN PAVILION
Aluminium extrusions used to support transparent plastic roof.

RUSSIAN PAVILION
340 tons of aluminium sheet and extrusions used in the roof.

SPANISH PAVILION
Aluminium window frames.

TURKISH PAVILION
Aluminium roof.

PALAIS DES TRANSPORT
150 tons of aluminium used in the roof structure.

PALAIS II
About 70 tons of aluminium used for the anodised facade.

PALAIS DE L'ELECTRICITE
An aluminium facade.

ROAD TRANSPORT VIADUCT
2,600 ft. viaduct will incorporate a decorative aluminium balustrade.

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ALUMINIUM *By Smith Bracewell*

IN common with other industries the aluminium industry is suffering from the effects of the growing recession in trade. Since the middle of 1956 there has been a slowing down in the rate of growth in demand for the metal. During 1957 deliveries of aluminium mill products in the U.S. (1,190,000 tons*) were 7½ per cent less than those of the previous year (1,288,000 tons). Deliveries of pig and ingot and of castings also decreased by 3½ and 5½ per cent respectively. In the U.K. despatches of aluminium products fell by 4.3 per cent (from 314,857 tons in 1956 to 301,876 tons in 1957), and exports of ingot and semi-fabricated metal declined (from 40,908 tons to 28,442 tons).

In the U.S. the cessation of purchases of aluminium for the National Stockpile in 1956 accentuated the unfavourable balance between supply and demand and contributed to the accumulation of large stocks in the hands of primary producers. By August, 1957, in accordance with its guarantees given during the accelerated expansion programme of 1950-55, the U.S. Government had agreed to take over some 250,000 tons of the accumulated surplus.

Production and Shipments

During 1957, for the first time since 1946, Free World production of primary aluminium was less than that of the previous year. This was due to the considerable reduction in output in Canada and the U.S., which outweighed the combined increase in most other countries. The decline in Canadian production was attributable mainly to losses arising from the five-months' stoppage of work between May and September caused by the strike at the Arvida reduction plants. At the end of the year, however, owing to the steady deterioration of the market position, Alcan found it necessary to restrict output by closing down 60,000 tons of its production facilities at Arvida and to postpone completion of 71,000 tons of ingot production facilities at Kitimat.

In the U.S. the fall in output of 23,000 tons was partly attributable to the closing down of some reduction facilities in the Pacific North-West during the early part of the year entailed by cuts in the available supplies of electric power from the Columbia River basin. Owing to the decreasing demand for the metal, however, in July Anaconda decided to shut down a quarter of its Montana reduction plant, and in December the Kaiser company cut the rate of output of its Mead plant by 20,000 tons per year. In January, 1958, Alcoa also decided to close down three of its 11 potlines at Alcoa, Tennessee. In Western Germany, there has recently been a 10 per cent cut in the rate of production.

In the U.K. the decrease in despatches of semi-fabricated aluminium was reflected in a 35 per cent reduction in the despatches of primary metal (from 276,216 tons to 213,341 tons) and by a 3.6 per cent fall in despatches of secondary metal (from 114,478 tons to 110,536 tons). Domestic primary production increased slightly but primary imports fell by 21 per cent (from 232,291 tons to 191,155 tons). Primary imports from Canada decreased by 25 per cent (from 200,000 tons to 147,000 tons), but those from Norway increased (from 13,481 tons to 16,343 tons) and those from other foreign countries increased from 14,206 tons to 23,235 tons, of which 15,449 tons came from Russia.

Although Canadian primary production during 1957 was 57,000 tons less than that of the previous year, exports of primary metal declined by only 5 per cent (from 451,000 tons to 425,000 tons). Exports to the U.S., which are safeguarded by sales contracts, actually increased from 192,000 tons to 202,000 tons. Exports to the U.K. decreased by 52,360 tons, but this loss was largely made up by increases of exports to Western Germany (from 4,780 tons to 16,900 tons) and to Brazil, Mexico, Italy, Australia and Sweden.

Prices

Despite the increased cost of production arising from wage increases following the strike at Arvida, the price of Canadian aluminium delivered in the U.K. was maintained at £197 per ton throughout the year. During the year, however, Russian aluminium became available in the U.K. and on the Continent at a price considerably below that of the Canadian metal. Despite the introduction of a system of "loyalty rebates" to U.K., consumers by the Canadian producer imports from the Soviet sphere continued to grow. This led Alcan to apply to the Board of Trade for the imposition of an anti-dumping duty on imports of crude metal originating in the U.S.S.R.

In July, 1957, owing to higher labour costs, U.S. producers found it necessary to increase the price of aluminium by 1 c. per lb. to 26 c. per lb. for pig and 28.1 c. for ingot.

As from April 1, 1958, however, Alcan reduced its Canadian price for 99.5 per cent metal by 2 c. a lb. to 22½ c. and this lead was followed by other producers. This reduction brought down the U.K. price to £180.

In France, government control over the price of aluminium was removed on October 17 and the price of the metal rose from 174.25 fcs. per kilo in March to 198 fcs. in late October. In Western Germany the price of imported, duty-free aluminium fell below that of the domestic product. In Australia a certain amount of the metal produced at the new Bell Bay reduction plant during 1957 had to be sold abroad at a loss and this has led the Australian Aluminium Production Commission to ask the Federal Government to restrict imports.

In September, 1957, in order to ensure adequate supplies of aluminium, Tube Investments, one of the leading producers of aluminium extrusions and tube in the U.K., concluded an agreement with the Reynolds group to combine the interests of both groups in the aluminium industry in this country and a new company, Reynolds/T.I. Aluminium was formed. Recently, this combine has acquired an interest in Venesta Ltd., who are large manufacturers of foil and collapsible tube. It may be anticipated that this will result in increased imports of the metal from the U.S.

The Northern Aluminium Co., a subsidiary of Aluminium Ltd., has recently decided to expand the capacity of its three fabricating plants at Rogerstone, Banbury and Birmingham in the U.K.

Expansion Projects

At the end of 1956 the total installed production capacity of the 72 aluminium reduction plants in the Free World amounted to 3,000,000 tons per year. Expansion projects under construction or definitely decided upon provided for an additional 1,200,000 tons and the implementation of these and other projects tentatively agreed

PRIMARY PRODUCTION

(Excluding Soviet sphere)
(In thousands of l.tons)

	1955	1956	1957*
U.S.	1,398	1,499	1,473
Canada	547	549	500
France	127	147	157
W. Germany	135	145	150
Norway	71	91	94
Austria	56	58	77
Japan	57	65	66
Italy	60	62	62
Switzerland	30	30	30
U.K.	24	28	29
India	7	7	8
Yugoslavia	11	14	18
Spain	10	13	15
Brazil	2	6	16
Sweden	10	12	13
Australia	1	9	10
Formosa	7	9	9
F. Cameroons	—	—	7
Totals	2,558	2,758	2,734

* With the exception of those relating to the U.S., the U.K. and Canada, the figures for 1957 represent estimates.

*Long tons used throughout unless otherwise stated.

upon was expected to raise the total to about 5,000,000 tons by 1965. U.S. capacity was to be raised from 1,586,000 tons to 2,429,000 tons, while Alcan announced in August, 1947, that it would raise hydro-electric capacity sufficiently to support 1,000,000 s.tons of smelting capacity in 1960.

Other proposals, including those in Ghana, French Guinea, the French and Belgian Congo and Surinam envisaged the construction of additional production facilities with an aggregate capacity of 1,400,000 tons per year. Despite the indications of a general trade recession, construction and preparatory work in connection with most of these projects proceeded without serious interruption.

In the U.S. installed production capacity was increased to 1,642,000 tons. The Kaiser company added 24,000 tons to its total capacity by extensions of its plants at Chalmette and Tacoma and by the completion of the first section of its new reduction plant at Ravenswood, Va. Reynolds completed the first stage of its projected expansion at Listerhill and started construction of its new plant at Massena, N.Y. Alcoa added to the production facilities at Point Comfort and proceeded with the building of its new 135,000-ton plant at Evansville, Ind. Work also continued on Harvey's new plant at the Dalles, Oregon, and on Ormet's new 160,000-ton plant at Clarington, Ohio. Completion of these projects is expected to raise U.S. capacity to 2,210,000 tons per year by the end of 1958. In January, 1958, however, it was reported that Alcoa was halting construction on its three expansion projects.

In December, 1957, the first 40,000-ton stage of the reduction plant built by the Canadian British Aluminium Co. at Baie Comeau in Canada commenced production, and work is proceeding on the second 40,000-ton stage. In addition, Alcan continued construction of the projected extensions of the Kitimat plant. As a result, Canadian capacity was increased to 740,000 tons. In October, 1957, however, Alcan decided to defer the completion of 80,000 tons of the planned 120,000 expansion at Kitimat.

In Norway, expansions of the Aardal and Sunndalsora plants now in progress will raise the production capacity of the State-owned A/S Aardal og Sunndal Verk from 65,000 tons per year to 100,000 tons by 1963 and to 150,000 tons by 1965. The new plant of A/S Elektrokemisk at Mosjoen is expected to commence operation during 1958. The country's total annual production capacity, including that of the four other privately owned plants, is expected to reach 154,000 tons by 1963 and 204,000 tons by 1965.

Alucam's new reduction plant at Edea in the French Cameroons, commenced production in February, 1957 and produced 7,500 tons of aluminium during the remaining part of the year. The capacity of the plant should reach 45,000 tons by 1959.

In July, an international consortium was formed to finance a £125,000,000 project for the production of alumina and aluminium based on power from the Konkouré River in French Guinea. The Konkouré project will consist of a power plant at Souapiti with an associated smelter to have an ultimate capacity of 165,000 s.tons. The French aluminium producers, Péchiney and Ugine, will hold 50 per cent of the controlling shares, 10 per cent each will be held by the German V.A.W., the Italian Montecatini and the Swiss A.I.A.G., and the remaining 20 per cent by Aluminium Ltd.

Another project, still in the preparatory stages and under study by the various interested parties, involves the construction of a hydro-electric generator of 1,000,000 kW. capacity at Sounda on the Kouilou River in French Equatorial Africa, and it was reported that the French Government was seeking a loan of £27,000,000 from the World Bank for this project. Assistance is also being sought from the Six-nation Colonial Fund provided for in the European Common Market Treaty.

The Belgian Government has approved the project for the construction of a hydro-electric generator at Inga in the Belgian Congo and responsibility for the detailed planning of the project has been delegated to the Lower Congo Development and Planning Institute. Construction work is expected to begin during 1958. Both this and the French Kouillou projects are dependent upon the construction of an aluminium plant of 300,000 tons capacity and some conflict appears to be developing between the rival claims of the two governments for financial assistance from the World Bank. Meanwhile, it is reported that the British Aluminium Co. has joined Aluminga, the international consortium established by Afral and the Reynolds company, to investigate the possibility of establishing an aluminium industry in the Inga area.

No arrangements for financing the Volta River project of Ghana have yet been

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announced. Dr. Nkrumah, the Prime Minister, recently announced that the good offices of the President of the U.S. had been successfully sought for assistance in financing the public aspects of the project. It is understood that the aluminium producing companies concerned in the project may be deterred by uncertainties regarding the eventual charges for electric power delivered from the Government financed hydro-electric generator.

It was recently announced that plans were being drawn up for the establishment of an aluminium producing industry in Angola, where extensive bauxite prospecting rights have been granted to the Billiton Co.

In August, 1957, an agreement was reached between Alcoa and the Surinam Government providing for the construction of a hydro-electric generator at Brokopondo in the Surinam River and of an aluminium plant of 60,000 ton capacity.

French primary aluminium production capacity, which totalled 150,000 tons at the end of 1956, will be increased to 225,000 tons by the completion of a 50,000-ton plant which is being built by the Pechiney Co. in South-West France and by the addition of 25,000 tons to the capacity of the Ugine Co.'s plant at Lannemezan. Both of these will be based on the natural gas resources of the adjacent Lacq area.

Bauxite and Alumina

Bauxite production in the Free World during 1957 is estimated to have amounted to about 18,300,000 tons, more than half of which was produced in the Caribbean region. Production in Jamaica was in the region of 4,600,000 tons, three-quarters of which was probably exported to the U.S. The remainder was converted into alumina in Jamaica. By mid-1957 the production capacity of the Kirkvine alumina factory of Alumina Jamaica Ltd. had been raised to 490,000 tons per year; alumina exports during 1957 amounted to 435,746 tons as compared with 207,333 tons in the previous year. The company's new factory at Ewarton will have a capacity of 190,000 tons per year and is scheduled for completion in 1959. The two factories will be capable of treating nearly 2,000,000 tons of crude bauxite per year. The Reynolds concern is now producing bauxite in Jamaica at the rate of 2,000,000 tons per year and the Kaiser subsidiary is to expand its rate of operations in the island to 4,000,000 tons per year. Jamaican bauxite production is, therefore, expected to exceed 6,000,000 tons per year and alumina production 680,000 tons per year by 1959. The Harvey concern is also searching for bauxite deposits in Jamaica.

In March, 1957, the Reynolds Co. commenced the shipment of bauxite from their mines in Haiti. The mines are equipped to handle 400,000 tons to 900,000 tons per year.

Work has recently been slowed down by the Demerara Bauxite Co. on the construction of an alumina factory in British Guiana. Bauxite production in this territory fell in 1957 to 2,106,800 tons from 2,480,983 tons in 1956.

Bauxite production in the U.S. decreased during 1957. The Anaconda Aluminium Co. s continuing its investigation of the project for the manufacture of alumina from clay and in October, 1957 the first shipments of clay were sent from Idaho to the company's pilot-plant in Montana. Recently there has been news of a proposal by the North American Coal Corporation and the Strategic Materials Corporation to develop a process for the production of alumina from low grade ores and coal mine waste at the Powhatan Mines near the Ohio River. Production of alumina at Alcoa's oldest factory at East St. Louis was terminated during 1957 and the company commenced production at Point Comfort where a factory of 600,000 tons capacity has been built.

By the end of 1957 the Sematan Bauxite Co. had completed its preparations for the mining of bauxite in West Sarawak, and mining was expected to begin during 1958 at the rate of 180,000 tons per year.

Further investigations of the bauxite deposits discovered in the Cape York Peninsula of Queensland by the Consolidated Zinc Corporation have indicated the existence of hundreds of millions of tons of material of a grade suitable for the manufacture of alumina. In January, a new subsidiary known as the Commonwealth Aluminium Corporation Ltd. was formed to promote the development of the deposits. The British Aluminium Co., which for some time, had been investigating the hydro-electric potentialities of New Guinea and other complimentary projects in Australia in association with the Commonwealth Government, has now become associated with the Zinc Corporation in the further exploration and development of the Cape York deposits. In May, 1957, it was announced that the Commonwealth Government had decided to sell its half interest in the New Guinea Resources Prospecting Co. to Consolidated Zinc.

A number of other companies are actively engaged in exploration for bauxite in Northern Australia.

TITANIUM *By A. Graham Thomson*

AFTER 12 years of uninterrupted expansion, the titanium industry received a severe setback in 1957, when reduced military requirements in the U.S., particularly for aircraft production, led to a drastic curtailment in Government orders for titanium metal. The impact of declining sponge production on the market for rutile was aggravated by over-production of this mineral.

Metal Production

The U.S. output of sponge titanium in 1957 is estimated at about 17,500 s.tons, being some 20 per cent higher than the 1956 production of 14,595 tons. On the other hand, sponge consumption at about 8,500 tons was 20 per cent lower. Much of the excess sponge metal was delivered to G.S.A. under the terms of Government contracts. Total production of mill products during 1957 was actually higher, rising to 5,653 s.tons from 5,065 tons.

The decline in U.S. production and consumption of titanium metal started in the spring of 1957 and was thereafter progressive. By the end of the year the monthly output of mill products had fallen to some 95 s.tons. The Business and Defence Services Administration anticipated that in the first quarter of 1958, shipments of titanium mill products would total less than 200 s.tons against 2,248 s.tons in the first quarter of 1957. Shipments rising to a level of 250-300 s.tons monthly were envisaged for the second half of 1956. The $25,000,000 titanium sponge plant operated by Cramet Inc. has closed production, as have several pilot plants.

Japanese output of titanium sponge rose in 1957 to 3,078 tons, compared with 2,512 tons in the previous year. On the other hand, exports declined to 2,337 tons from 2,527 tons in 1956, due to a sharp contraction in shipments to the U.S. Since July, production has been curtailed.

In the U.K., production of titanium metal by Imperial Chemical Industries Ltd. remained at about the 1956 level of 1,700 l.tons. During 1957, the £3,000,000 plant, operated by I.C.I.'s Metal Division for the manufacture of titanium sheet and rod came into operation. The titanium melting plant at Witton is being re-equipped to enable it to produce ingots weighing up to 2 tons. New titanium alloys were announced during the year by William Jessop and Sons Ltd.

Formosa is to produce 5 tons monthly of titanium metal, according to the State-owned Taiwan Alkali Corporation. Initially, it is planned to import ores from South-East Asian nations. Later, ore deposits in Formosa will be explored.

The Swedish Iron and Steel Works, Avesta Jernverk, is reported to be expanding the commercial production of titanium metal, mainly for the chemical industry.

It is considered probable that the U.S.S.R. has a titanium metal and alloy production second only to that of the U.S.

Outlook for Titaninm Metal

At present about two-thirds of the titanium produced for aircraft goes into jet engines, reflecting the fact that at temperatures of about 900 deg. F., titanium is the only weight-saving substitute for steel. As the transition from manned aircraft to missiles takes place, temperatures of missile airframes will reach hundreds of degrees. Titanium might, therefore, find a growing outlet in missile production.

Failing restoration of Government requirements to their former level, titanium's future markets must be sought mainly in commercial fields, in which price will be a major consideration. U.S. sponge metal producers reduced the price of Grade A-1 sponge from $2.75 to $2.25 per lb. on June 3, 1957, which compares with $15 in 1950, and on the same date prices of mill products dropped by an average of 10 per cent. In April, 1958, E. I. du Pont de Nemours & Co. cut the prices of A-1 and A-2 sponge to $2.05 and $1.85 a lb. respectively. Nevertheless, U.S. mill products still sell at 10-20 times the price of the same product in stainless steel. It is believed, however, that within five years titanium sheet, rods and bars should sell at one-third to one-half of current prices. Because of its superior properties, the metal will then be economic for many uses in the chemical industries and certain consumer products. It is estimated that from 50 to 100 different applications have already been made in prototype products.

On September 4, 1957, Titanium Metals Corporation of America announced the largest single non-military order in the history of the industry. It involved 7 miles of titanium tubing for Freeport Sulphur

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Co., to be used in processing equipment for treating cobalt-nickel concentrates.

During 1957 various technological developments likely to result in further cost reductions were announced. In the U.S. the Curtiss-Wright Corporation has developed new production manufacturing methods for the extrusion of titanium jet engine parts directly from cast ingots. The recently formed Mallory-Sharon Metals Corporation will use what is claimed to be the lowest cost process developed to date for the production of titanium sponge. A new process for refining titanium, using the tetrachloride as the starting material, is being developed in Japan. A process claimed to be the first continuous automatic method of extracting titanium from ilmenite ores is being investigated by leading Belgian steelmasters.

Rutile and Ilmenite

Australian production of rutile rose to an estimated 120,000 l.tons in 1957 from 96,000 tons in 1956 and 60,000 tons in 1955. Despite substantially increased shipments to the U.S., markets were unable to absorb the increasing offerings and became progressively weaker. By the end of 1957, the London quotation for rutile 95-97 per cent had fallen to £42-£43 per ton c.i.f. Australia from £80-£85 per ton when the year began. By the end of February it had declined further to £38-£40 per ton. On the U.S. market the price of rutile fell during 1957 from $190-$230 per s.ton to $120-$125.

U.S. rutile imports in the first nine months of 1957 reached the all-time peak of 66,083 s.tons, which compares with the previous record of 48,906 tons imported during the whole of 1956. Apart from 94 tons imported from French West Africa, Australia was the sole supplier. U.S. domestic production at an estimated 11,800 tons was slightly lower than the previous year's output.

Ilmenite prices in the U.S. remained constant throughout 1957 at $25-$30 per l.ton, while in London the price of Malayan ilmenite fell by only a few shillings to £11 per l.ton c.i.f.

U.S. domestic ilmenite production is estimated to have increased by 4 per cent over 1956 to the new peak of 710,000 s.tons. In the nine-months' period ending Sept. 30, 1957, the U.S. imported 352,488 s.tons of ilmenite concentrates.

Canada is the world's leading producer of titanium slag and possesses the largest ilmenite deposits. In the autumn of 1957 Canadian Titanium Pigments opened the Dominion's first pigment plant, costing $15,000,000, at Varennes, Que. Slag is fed to the plant from Quebec Iron and Titanium, which operates five electric smelting furnaces at Sorel. This company recently embarked on a $16,000,000 expansion programme to raise capacity to 375,000 tons annually by 1959.

The Ceylon Government has approved the setting up of a National Ilmenite Corporation with an initial capacity of Rs.8,000,000. Work has started on the separation of ilmenite from the Pulmoddai sands.

Deposits of ilmenite found in 1956 near Jossingfjord in Western Norway are now estimated at about 350,000,000 tons, of which 166,000,000 tons have been mapped. Titania A/S, a subsidiary of American Lead Co., has been given a concession to exploit the deposits, the objective being an ultimate output of 400,000 tons annually.

The extraction of ilmenite, rutile and zircon is to be undertaken in Natal by Umgababa Minerals Ltd., an associate company of Anglo American Corporation of South Africa Ltd. Ilmenite will be produced at the rate of 100,000 tons a year and zircon and rutile at 10,000 tons and 7,000 tons respectively.

In assessing the outlook for titanium minerals, it should not be overlooked that, despite the advent of a titanium metals industry, by far the largest outlet continues to be in the manufacture of pigments.

MAGNESIUM

MAGNESIUM metal is the lightest of all structural materials in common use. Preliminary figures place the total world output of primary metal during 1957 at 168,000 s.tons compared with 157,000 tons in 1956.

The U.S. continues to be the largest producer (and consumer), its 1957 output being reported at 81,263 s.tons against 68,346 tons for the previous year. At an estimated 60,000 tons the output of Russia, the second largest producer, was virtually unchanged from 1956. On the other hand, Canadian production fell last year to 8,037 tons from 10,000 tons in 1956. Norway also showed a slight decrease (from 8,267 to 8,000 tons), while the U.K. production (including remelt metal) declined to 3,690 tons from 4,961 tons. Small increases were indicated for Italy (4,300 tons) and France (1,730 tons).

U.S. consumption of primary magnesium in 1957 was estimated at 47,000 tons, being 12 per cent below 1956. Since military applications take about 45 per cent of the total amount consumed, the decreasing level of military aircraft programmes is clearly indicated in this decline. Another major factor was a drop in requirements of magnesium as a reducing agent to produce titanium. At the close of 1957 producers' and consumers' stocks were estimated to be 75 per cent higher than on December 31, 1956.

The Dow Chemical Co. purchased for $20,000,000 the government-owned facilities near Freeport, Texas, known as Plant B. Dow operated this plant for government stockpiling until the end of 1953, since when it has leased and operated it on its own account. This plant has been shut down. The company has been producing magnesium from its Plant A at Freeport since 1941.

Canada's two magnesium producers are Dominium Magnesium and the Magnesium Co. of Canada. High U.S. tariffs hampered the marketing in that country of Dominion Magnesium's high purity (99.9 per cent) magnesium. This led to the establishment of a new company, Alabama Metallurgical Co., owned jointly with Brooks and Perkins Inc., of Detroit, which is constructing a $4,500,000 plant with an ultimate capacity of 12,000 tons of magnesium a year. The metal will be made from dolomite by the Pidgeon ferrosilicon process.

In the U.K. the current electrolytic reduction of magnesium chloride by Magnesium Elektron Ltd. at Clifton Junction, Manchester, is to be superseded by a silico-thermic process, but no commercial scale plant for the latter process has yet been erected. Magnesium Elektron planned to erect a £1,000,000 plant at Hopton, near Wirksworth, Derbyshire, to extract magnesium from limestone deposits, but owing to the credit squeeze this plan was postponed.

A plant is projected for extracting magnesium from sea water at Saint Antioco, Sardinia.

This year the magnesium industry in the U.S. is expected to operate at a lower level of activity than in 1957. However, with an acceleration of defence programmes, increased production of missiles, and a growing use in civilian applications, an early resumption is predicted of the upward trend. The U.S. output is expected to treble during the next ten years to an annual rate of 200,000 s.tons, according to Mr. E. H. Perkins, president and chairman of Brooks and Perkins, Inc. Consumption will be stimulated by the fact that the supply of the necessary raw materials is virtually inexhaustible, while the extremely light weight magnesium promises endless uses.

Although magnesium tooling plate was introduced only about three years ago, its sales in the U.S. are now some 500 s.tons annually and this market is very rapidly expanding. Increased use was reported for a new magnesium alloy with a temperature range to 890 deg. F. In the military field a tripled consumption is foreseen for magnesium-thorium alloys.

The price of magnesium has remained unaltered in the U.K. at 2s. 5½d. per lb. since December 1, 1956.

Magnesite

The principal uses of magnesite are in the production of refractories, magnesium oxychloride cement and magnesium salts.

World output of crude magnesite in 1957 is estimated at 5,200,000 s.tons as in the previous year, of which 1,262,000 s.tons was produced in Austria, 703,500 tons in the U.S. and 266,000 tons in Yugoslavia. Other producers included India (95,000), Greece (80,000), Australia (80,000), Spain (43,000) and Union of South Africa (36,000).

Magnesian ores mined in the U.S. last year also included brucite, olivine and epsomite. A new magnesia plant was begun in the U.S. and plans were under way for another, near Freeport, Texas. Large additional facilities were put into operation at three refractory plants.

Magnesia derived from sea water, well brines and bitterns accounted for 53 per cent of U.S. domestic production in 1956, the remainder being produced from magnesite, brucite and dolomite.

By agreement with the Greek Government, the American-Austrian Magnesite Co. has taken over facilities at the magnesite mine in Vavdos-Chalcidice, which is expected to produce 23,000 tons of magnesite annually.

Plans are said to be in hand for the exploitation of a new magnesite deposit near the Russo-Czech border estimated to contain some 100,000,000 tons of high-grade material.

The Steel Industry Metals

IRON AND STEEL • MANGANESE • NICKEL

CHROMIUM • COBALT • TUNGSTEN • MOLYBDENUM

VANADIUM • COLUMBIUM • TANTALUM

IRON AND STEEL *By J. H. Thompson*

STEEL marches on. It does so moreover at an ever increasing pace. Little more than a century has elapsed since Henry Bessemer first taught the world how to convert iron into steel. He can have had little idea of the extent of the industrial revolution which he had inaugurated. At first the substitution of steel for wrought iron was distinctly hesitant. Even in 1870 steel production was insignificant, but as engineers began to recognize the outstanding merits of this material for all types of constructional work, production began to increase at an ever accelerating rate, and in 1956—the complete statistics for 1957 are not yet available—world ingot production had reached the unprecedented total of 278,000,000 tons; nearly two-and-a-half times the 113,000,000 tons recorded in 1945.

For such a remarkable rate of expansion, never surpassed nor even equalled by any other basic industry, one explanation is obvious. Apart from the national growth of demand which perforce remained unsatisfied during the period of "Hitler's war," the need for restoring the ravages of conflicting world armies imposed excessive calls for steel in its manifold forms, and the industry in all the principal centres of production, in this country and abroad, was not slow to respond.

Even yet, thirteen years after the cessation of hostilities this task has not been completely accomplished. Reconstruction still continues although the main impetus of demand for this purpose has gradually lost some of its momentum.

Other requirements have supervened. The use of steel is ever extending its range. First requisite for the development of the backward countries, for the exploitation of their national resources and the advancement of their standards of life, for the improvement of road and rail communications, is an unlimited supply of steel. New uses are also developing for refrigerators, washing machines and other domestic appliances; in agriculture and even in the exploration of outer space.

In some of these spheres steel has its rivals, but it is at once the most durable and the cheapest of all metals and it seems improbable that the world demand for steel will be appreciably arrested by competitive materials in the foreseeable future.

Recent events have imposed a recession, which has been most pronounced in the U.S.A. In the U.K., in various Commonwealth countries and in other foreign states, the struggle to stem the encroaching tides of inflation has led to the imposition of import restrictions and reduced purchases of iron and steel manufactures. But the economic blizzard has raged most furiously throughout North America where the army of unemployed exceeded five million and ingot production fell to little more than 50 per cent of capacity.

Such circumstances pose the question: "Has the steel industry reached its zenith?" The answer of all the leading authorities is an emphatic negative, and they do not confine themselves to any verbal assurances. In all the leading centres of production ambitious projects are in hand for further expansion of capacity.

Capacity Still Being Expanded

During the past twelve months annual capacity of American steel has been raised by 7,250,000 tons to the fantastic figure of 140,700,000 tons which represents an increase of 46,000,000 tons in ten years, and further huge developments are in progress.

U.K. steel production, which reached 21,700,000 tons last year, was the highest ever and approved development schemes covering the ensuing five years provide for a further investment of £600,000,000 in capital works to increase capacity to 28,290,000 tons.

WORLD CRUDE STEEL PRODUCTION

(in thousands of metric tonnes)

	1956	1957	% Inc.
U.S.S.R.	48,610	**51,000**	5
Western Germany	23,189	**24,507**	6
United Kingdom	20,991	**22,047**	5
France	13,399	**14,096**	5
Belgium	6,375	**6,262**	−2
Italy	5,908	**6,773**	5
Poland	5,014	**5,300**	6
Czechoslovakia	4,882	**5,238**	7
Luxembourg	3,456	**3,493**	1
Saar	3,374	**3,461**	3
Eastern Germany	3,110	**3,290**	6
Sweden	2,425	**2,500**	3
Austria	2,078	**2,500**	20
Hungary	1,425	**1,365**	−4
Spain	1,243	**1,325**	7
Netherlands	1,042	**1,183**	14
Yugoslavia	885	**1,020**	14
Rumania	782	**850**	9
Other European countries	1,157	**1,290**	11
United States	104,524	**102,263**	−2
Japan	11,106	**12,564**	13

In the six countries affiliated to the European Coal and Steel Community, where the five year transition period expired on February 10 of this year, the High Authority has reported the attainment of an aggregate ingot output of 59,800,000 tonnes, against 56,800,000 tonnes in 1956 and 41,800,000 tonnes in 1952, an increase over the five year transition period of 42.6 per cent. Incidentally the E.C.S.C. has become the second largest steel producing country in the world, taking precedence over the U.S.S.R. and ranking next to the U.S.

So the story of expansion continues particularly in the Far East. There the need for increased productivity has become the most pressing of all industrial problems. In 1956 China, India and Japan with a collective population of over 1,000 million produced no more than 17,000,000 tons of steel. Not surprisingly these countries with immense natural resources are ambitious to develop their steel production and consumption. China, India and Japan have embarked on important development plans designed to double their output approximately in the next three years, whilst most of the other countries in the Far Eastern area are also proposing to establish or expand national iron and steel industries.

All, however, are confronted with the difficult problem of limited financial and physical resources. In general, their difficulties arise from lack of the raw materials of steel making and of small domestic markets. India, for example, is proceeding with plans for an increase of production, which amounted to no more than 1,800,000 tons in 1956, to 6,000,000 ingot tons by 1961, but the rate of progress has apparently been slowed down and further capital investment plans designed to reach an annual output of 9,000,000 tons are still very much in the air.

This, of cause, does not exhaust the list of capital development schemes which are also proceeding in other countries: e.g., Soviet Russia, Yugoslavia, Spain, Latin America, Canada, Australia and South Africa. Everywhere the emphasis is on expansion and the planned increases in U.K. production, vast though they are, will hardly suffice to maintain the proportionate British contribution to world trade.

U.K. Steel Industry's Capital Needs

At this juncture it is unfortunate—to use no harsher term—that the outlook for the steel industry in this country should be bedevilled by political uncertainty. Having been nationalized and denationalized during the post-war era steel is now threatened with re-nationalization. It is a threat which can only be

implemented, if at all, after the next general election, but the leaders of the Labour Party have emphasized their determination, if returned to power, to press on with legislation to resume state ownership of the industry. The steel makers have already launched a campaign to enlighten the electorate with whom the ultimate verdict rests.

The possibility of a fundamental change of this character has immensely increased the difficulties of the industry in raising at least twice as much external finanaces for expansion in the next five years as in the whole of the post-war decade. It was originally estimated that of the estimated cost of the third development plan amounting to £600,000,000, about two-thirds could be provided out of the individual resources of the industry.

There is no doubt that had the industry been free from the possibilities of re-nationalization, and the financial position been less stringent, many of the steel companies would have been on the market for the provision of more capital. In the event few have been able to do so. Borrowing has become infinitely more difficult and investors are chary. It is premature to suggest that any of the approved development plans will be abandoned, but the altered circumstances may compel a re-phasing of some of the larger projects, which are summarized in the appended table.

APPROVED DEVELOPMENT PLANS

	Approximate cost	Year of completion
Colvilles	£32,000,000	1958–62
Consett Iron ...	£30,000,000	1962
Dorman Long	£15,000,000	1958
Guest Keens ...	£30,000,000	1958–60
Richard Thomas & Baldwins ...	£80,000,000	—
South Durham	£40,000,000	1958–60
Steel Co. of Wales	£52,000,000	1959
Stewarts & Lloyds	£41,000,000	1958–62
John Summers & Son	£18,000,000	1958–59

To complete the picture the Iron and Steel Holding and Realization Agency reveals that during the past year controlling interest of a further 10 of the 71 companies originally nationalized has been sold, and of the 47 now disposed of I.S.H.R.A. still holds for future disposal firm charge securities of 11 companies. In the aggregate the agency still retains investments amounting to £223,700,000, a reduction of £140,600,000 since 1953.

In organized research works, in technological achievement, in fuel economy and in increased productivity, the achievements of British steel in the past year have been highly creditable and the result has been that British steel prices compare favourably with those of any of the leading producing countries.

Under the stress of keener competition in world markets the margin between British and European steel prices has been narrowed considerably, but British products are still cheap, exports last year increased in volume by about 10 per cent to 3,160,000 tons, and above all British industries engaged principally in the export trade, have enjoyed the inestimable advantage of cheap steel. The first price reductions in the steel industry for 20 years have recently been announced.

U.K. STEEL RECORDS

	1955 Tons	1956 Tons	1957 Tons
Pig iron production	12,470,000	13,170,000	**14,283,000**
Steel production	19,791,000	20,659,000	**21,699,000**
Imports	2,318,000	2,122,200	**1,284,500**
Exports	2,727,800	2,823,100	**3,160,300**
Scrap imports	12,859,300	981,447	**666,445**
Ore imports	16,177,000	14,730,000	**16,417,000**

Technical Progress

The principal technical development has been the increasing use of oxygen in the steel converters and large-scale developments in the provision of new oxygen generators in close proximity to the big steel plants are now in progress.

It is, however, in the U.S. that the most important progress in this direction has been accomplished. Described as U.S.A.'s fourth largest steel producer, the Jones and Laughlin Steel Corporation has brought into operation at their Aliquippa, Pennsylvania, works a new plant for the production of steel by the basic oxygen process which, with a rated capacity of 750,000 tons per annum is, said to be the largest in the world.

Naturally the decision to embark on the basic oxygen process was preceded by a thorough study of the economics of the new system, which produces a steel offering the advantages of a low nitrogen, phosphorus and sulphur content. It is claimed for the new process that it is simple to operate and that the new crucibles can be provided on a capital investment of only $15 per annum ingot ton, compared with at cost $40 for new open hearth facilities.

Already some of the British steel companies contemplate the installation of basic Bessemer converters to replace open hearth furnaces. If the American plant continues to yield satisfactory results the dominance of the open hearth steel furnace in this country may soon be seriously challenged.

IRON ORE

Iron ore is the one indispensable raw material of the iron and steel industry. In the heating of the steel furnaces, oil, tar and gas have in some measure superseded coal and it is not beyond the bounds of possibility that the extraction of pure iron from ores may be accomplished by methods other than the use of coke in the blast furnaces. But iron ore in ever-increasing quantities must be provided, not only to match the growth in pig iron production but also to compensate for the more limited expansion of scrap supplies.

In this respect British experience is typical. Last year our blast furnaces used 11,000,000 tons of pig iron and an equal tonnage of ferrous scrap to produce 21,000,000 tons of steel. But for several years past scrap has not been available in the required tonnages. Last year British scrap imports declined by nearly 50 per cent and in the current year they may not exceed 1,000,000 tons, against 2,000,000 tons in 1954 and again in 1955.

Steel-producing countries are reluctant to release any of this material for export. Overseas scrap supplies are scarce and prices prohibitive.

These are circumstances not unforeseen and British steel makers have planned their economy accordingly. To raise pig iron production to 20,000,000 tons in 1962, it is estimated that no more than 13,500,000 tons of scrap will be available and that the average use of pig iron in the steel furnace charges will have to be raised from 50 to over 60 per cent.

The implications of this decisive change have been fairly and squarely faced. Vast developments are in progress to ensure supplies of ores from home and foreign sources which are adequate for all the great centres of iron and steel production. Plans are afoot to raise the British ore output from 16,250,000 tons in 1956 to 22,000,000 tons in 1962 and in the same period it is estimated that imports will have to be increased from 13,250,000 tons to 23,000,000 tons.

About 85 per cent of the total supply of domestic ores is raised in the Northampton Sands, Frodingham and Oxfordshire areas; and as the yields from some of the older ore fields are approaching exhaustion, this proportion is expected to increase. Furthermore, an exhaustive survey of the area to the north-east of Northampton Sands has been undertaken and it is hoped that this ore field, properly developed, will provide a substantial augmentation of home ore supplies.

All the arrangements for the acquisition and transportation of imported ores are now in the hands of the newly created B.I.S.C. (Ore) Ltd., who have shown no lack of either vision or enterprise in the discharge of their responsibilities.

Problems of Transportation

There is no lack of iron ore: known supplies far exceed present and potential requirements, but their accessibility is governed by limitations of transport. Nor is it merely a question of bringing the ore from the minefields to the loading ports. Huge carrier fleets are required; discharging equipment must be commensurate with the bigger tonnages which are or will be needed, and although considerable improvements have been effected more, much more, requires to be accomplished.

The American steel masters have gone in for gigantic carriers with capacities ranging up to 90,000 tons, but vessels of this size are limited to the use of the few loading and discharging ports with deep water facilities.

The U.K. has no such discharging port, though one may be provided sooner or later at Milford Haven. The great bulk of ore supplies, however, is shipped from ports which have no such accommodation and B.I.S.C. (Ore) Ltd. is now sponsoring

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Even when these carriers are all in commission, their maximum capacity will not exceed 10,000,000 tons per annum and still larger tonnages will have to be carried by auxiliaries chartered in the open market.

B.I.S.C. (Ore) Ltd. has not been slow to assume that the ore would always be available for it to buy. The needs of other countries are increasing as rapidly or even more rapidly than ours, and the British authority has been moved to enter into direct investments in Sierra Leone and French Guinea. It is also financially interested in the development of new deposits in Mauritania (West Africa) and, in addition to long term contracts with traditional suppliers in Sweden and North Africa, has entered into others for a share of Canadian ores, which amounted to 23,000,000 tons in 1956 and is growing rapidly.

British supply problems, of course, pale into comparative insignificance compared with those of U.S. steel. An American expert forecasts that U.S. ore requirements in 1980 will reach 180,000,000 tons and the assurance of supplies of this magnitude will obviously call for numerous developments over the whole of the American Continent. Apart from the intensive exploitation of Canadian, Venezuelan and Brazilian deposits, American steel plants are now using taconite pellets from various sources, whilst Ruhr steel magnates are seeking to increase their supplies from French Africa, Canada and Brazil.

MANGANESE *By A. Graham Thomson*

UNDER the stimulus of the high prices formerly prevailing, world production of manganese ore has been rapidly expanding and was again substantially higher in 1957, though no reliable estimate can be given as yet. In 1956 it amounted to 11,070,000 l.tons. Approximately 95 per cent of the total supply is used in the manufacture of steel, 3 per cent in the dry battery industry, and the balance in the chemical industry.

Reduced activity in the steel industry in many countries, coupled with rising production of manganese ore, resulted in more difficult marketing conditions, but falling freight rates were largely responsible for the downward trend in prices. At the end of the first quarter of 1958 46-48 per cent ore of Indian origin was quoted in Europe at 106d.-112d. compared with 140d.-150d. at the beginning of 1957, but in the absence of business prices were largely nominal. In contrast to metallurgical ore, manganese dioxide remains very firm, constituting by far the biggest tonnage ore market still in under-supply.

Production and Marketing

The most dramatic event of 1957 was the emergence of Brazil as the leading exporter of manganese ore, with total shipments of 820,000 tonnes, of which the U.S. bought 400,000 tonnes for stockpiling. It is expected that this year production will not exceed 600,000 tonnes, of which the U.S. authorities will buy only 75,000 tonnes. The opening up of Brazil's Amapa deposits has made the U.S. very much less dependent on Indian and other sources of manganese, and this may have a far-reaching impact on the pattern of the world manganese trade.

In 1957, U.S. imports of manganese ore rose to an estimated 2,875,000 s.tons (gross weight) against 2,215,164 tons in 1956. The year's consumption amounted to 2,264,000 s.tons, and at the year's end stocks at plants totalled 1,450,000 tons. Brazil was the largest supplier, followed by India, Ghana, Union of South Africa, Mexico, Cuba and Belgian Congo.

India's total exports of manganese ore fell to 954,837 l.tons in 1957 from the previous year's total of 1,458,000 l.tons. Latterly, Indian manganese has been losing ground in the U.S., largely because of the Government's new mineral export policy and the incursion of the State Trading Corporation into this field, but has been finding a growing outlet in Japan and also in Western Germany. The prospect of a better deal between the U.S. and India is regarded as unlikely at the present time. At the beginning of February, 1958, the Indian Government abolished the export duty on manganese ore of less than 42 per cent grade and reduced the duty on ore of 42-44 per cent manganese content. In April, 1958, the Indian Government withdrew restrictions on the free export of manganese ore and allowed shippers to utilize their quotas for all grades.

The manganese mines at Joda in Orissa have received high priority for expansion. This is due to the programme of Tata Steel in Jamshedpur, where 2,000,000 tons will be produced by 1960. The new ferro-manganese plant will have an initial capacity of 30,000 tons a year and is being designed so that output can be stepped up to 100,000 tons.

South Africa produced 787,883 s.tons of manganese ore in 1957 compared with 717,545 tons in the previous year. Increased manganese exports are planned by this country, whose reserves are among the largest in the world. Since 1953, when over 700,000 s.tons were sold overseas, activity has declined, mainly because of inadequate facilities for trucking the ore and loading it on to ships. To meet this situation the harbour at Port Elizabeth is being developed and rail communications are being improved. No improvement in the supply of trucks is expected in 1958.

Shipments from Ghana during 1957 totalled 684,500 l.tons (674,995 in 1956).

During the period Jan.-July, 1957, shipments of manganese ore from Cuba declined to 97,507 tonnes from 148,394 tonnes in the corresponding period of 1956. Inter-American Industries Inc. is now operating in Oriente Province the first heavy medium plant to be built in Cuba for the concentration of high grade manganese ores, a monthly rate of 1,000 tons of concentrates being attained.

Negotiations are being continued by Strategic Manganese Corporation for finance to construct its large manganese and smelting operation at Woodstock, New Brunswick, Canada, which will be designed for an initial production of 70,000 tons of ferromanganese annually and 77,000 tons of ingot iron. Extensive test work at the prototype smelter of Strategic-Udy Metallurgical and Chemical Processes in Niagara Falls, Ontario, has demonstrated that the electro-metallurgical process worked out is feasible and profitable on a commercial basis for the treatment of low grade ores.

A total of 414,435 tonnes of metallurgical grade ore and 77,053 tonnes of chemical were mined in Morocco during 1957, the latter being almost double the 1956 figure.

Comilog (Compagnie Minière de l'Ogooue), the company which plans to mine manganese deposits at Franceville, French Equatorial Africa, has called for tenders for the construction of a 280 km. railway to carry the ore from the terminus of an 80 km. overhead cable railway to Pointe-Noire on the Atlantic Coast. Ore reserves are put at a minimum of 100,000,000 tonnes with a metal content of 48-50 per cent.

In Egypt, average monthly production of manganese ore by the Sinai Manganese Mining Co. is reported to be 10,000 tonnes. It is planned to step up output to an annual rate of approximately 250,000 tons by the end of 1958. Deposits of manganese estimated to be large enough for an annual production of about 100,000 tons of ore may be developed by a special company to be set up by the Ministry of Industry. This deposit is located in the southern part of the Sinai Peninsula.

Work began early in 1958 on a $40,000,000 manganese project in British Guiana. The North-West Guiana Mining Co. Ltd. plans to produce 10,000 tons of manganese monthly, starting in 1959, with a rise to 30,000 tons by 1961. The company proposes to construct a 38 mile railway line to bring the ore to a shipping point.

Practically half the total world production of manganese ore comes from the U.S.S.R. It is reported that a new iron and manganese ore deposit at Karazhai in the Karaganda district of Kazakhstan is being opened up. The main pit, which is expected to yield up to 2,200,000 tons a year, is nearing completion.

The Outlook

By the end of the first quarter of 1958 there were few indications to suggest that there would be any substantial pick-up in demand in the months immediately ahead, particularly having regard to the uncertain steel situation. The total quantity of manganese ore which the U.K. will buy in 1958 is expected to be less than was bought for 1957, due to the high level of stocks—a situation which also exists in other steel-producing countries.

An encouraging development is the expanding production of manganese nickel stainless steel, which continued to gain in the U.S. last year despite the setback in other major groups of stainless steels.

Looking ahead, the probability that by 1980 world steel production may be in the region of 940,000,000 tons—roughly treble the output in 1956—augurs a rising demand for manganese ore.

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NICKEL

THE year 1957 witnessed a transformation in the supply-demand situation for nickel. After many years of shortage, the combined supply of market and premium price nickel came into close balance with demand during the latter part of the year. In fact, in the U.S.—the largest market—the supply exceeded the demand. By March, 1958, stocks in the hands of Canadian producers and of the U.S. Government—excluding nickel in the U.S. Government stockpile—were approaching 50,000 s.tons.

The changed position is ascribed to record high Free World production of nickel, sharply reduced defence demands, and the efforts of the U.S. Government to divert to industry all nickel scheduled for stockpile intake. While Free World defence requirements were substantially lower than in 1956, civilian consumption increased to the extent of approximately compensating for the reduced defence consumption.

Production and Distribution

Dr. John F. Thompson, Chairman of Inco, estimates Free World nickel supplies in 1957 at 245,000 s.tons, compared with the previous record totals of approximately 225,000 tons in 1956 and 212,500 tons in 1955. Deliveries of the metal by Canadian producers reached the new record of about 180,000 s.tons, representing approximately 75 per cent of the Free World's entire supply. Of the balance available to the Free World, Cuba accounted for about 9 per cent, the U.S. 4 per cent, and New Caledonia, Japan and others 12 per cent.

International Nickel, the world's largest nickel producer, operated at capacity in 1957 for the eighth consecutive year. Its deliveries of nickel in all forms exceeded 145,000 s.tons, being about 2,500 tons higher than those of the previous year. Falconbridge's output was about 25,000 s.tons and that of Sherritt Gordon 10,000 s.tons. These two companies plan to increase their respective production to 27,500 and 12,500 s.tons annually

The U.S. Government-owned plant in Nicaro, Cuba, is understood to have increased its production facilities to 25,000 s.tons annually. Disposal of this plant to private industry has not yet been accomplished.

A new nickel refining process, claimed to be more efficient than the company's present practice, has been developed by International Nickel. Canadian and U.S. patents are pending.

Expansion and Exploration

A start was made during 1957 on Inco's $175,000,000 project in Northern Manitoba, which involves the construction of two nickel mines, a new town, hydro-electric power installations, and a 30-mile spur railway. Construction of the rail spur has already been completed. This project alone will increase Inco's annual output by 37,500 s.tons, bringing the company's capacity to 192,500 s.tons in 1961.

Last year also saw the start of a major programme launched by a number of companies in Ungava, Quebec. Sufficient encouragement was obtained to allow full-scale exploration to be resumed this year. Nickel exploration in the sub-Arctic was further encouraged by the start of production at North Rankin Nickel Mines in the North-West Territories.

Freeport Sulphur Co. has embarked on initial expansion of its nickel project in Cuba, for which it has arranged to borrow a total of $100,250,000. Production from the Moa Bay properties is expected to begin in mid-1959. Annual output of 25,000 s.tons of nickel metal and 2,200 s.tons of cobalt metal will make Cuba the second largest nickel source in the world and the largest cobalt source in the western hemisphere. The project will increase U.S. supplies of nickel by some 15-20 per cent.

Le Nickel, the New Caledonian nickel producer, plans to raise its productive capacity to 27,000 tons of metal by 1960.

On September 4, 1957, the Philippines Cabinet approved the terms and conditions under which bids would be accepted for the development of the nickel deposits in the Surigao mineral reservation. Owing to various unattractive features in the conditions of the bid, foreign interest waned and no offers were received. The possibility of issuing a new invitation under more favourable terms is under examination.

The finding of what might be the largest nickel deposits yet uncovered in the U.S. has been reported by the Nickel Corporation of America. Pitting operations in Josephine County, Oregon, have established an indicated ore content of about 8,000,000 tons in one of three areas being worked, with a grade of 1.1 nickel or better.

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Underground and pilot plant operations at the Empress Nickel Prospect, near Gatooma, Southern Rhodesia, were suspended at the end of 1957, the property being placed on a care-and-maintenance basis. Exploration and testing are being continued.

Prices

The official price of 99.5 per cent nickel in the U.K. remained unaltered throughout 1957 at £600 per l.ton.

Due to the improved supply position, the premium free market is on the way out. At the time of writing nickel metal on the Continent is indicated at from £750 to £800 per ton, having fallen from well over £2,000. In the U.K. the premium has virtually disappeared.

The Outlook

Three factors condition the outlook for 1958. The first is the extent to which old nickel uses will be restored. Secondly, comes the question of defence requirements, in which it must be remembered that the U.S. is at present in a transition period from a reduction in manned aircraft to an increase in the production of missiles. A third factor is the state of the Free World economy, particularly in the U.S.

In March, 1958, a statement by Inco announcing a 10 per cent cut in its Canadian production, said that the output of nickel substantially exceeded total market demand as well as consumption, and that the large stocks in the hands of the company and the U.S. Government were expected to continue to climb. A second cut of 10 per cent was subsequently announced which reduced the company's output of nickel to about 125,000 s.tons a year.

The creation of large markets in preparation for 1961—the year in which nickel production goal of between 325,000 and 337,500 s.tons will be achieved—is a major task confronting producers. In recent years many nickel-containing alloys have been replaced by substitutes using less nickel or none at all. The prospect of a surplus of nickel will enable many of these specifications to be revised, as well as providing an opportunity of developing the uses which have been lying fallow for several years. Expanding outlets are foreseen in the field of high temperature materials and also in stainless steel, electroplating, and special alloys for electronics and instrumentation.

Despite the existing surplus, it is still considered that in the absence of a major world recession, the industry's chief problem is to make enough nickel available for future needs.

CHROMIUM

CHROMIUM is extensively used in the steel industry and is an important ingredient of stainless steels and high temperature materials. It also has major refractory and chemical uses.

For almost all 1957 chrome ore was more freely available and in reduced demand. In the second half of the year the market weakened considerably, among the principal causes being a recession in stainless steel production in the U.S., greatly increased shipments of Rhodesian metallurgical chrome, and large tonnages of high-grade chrome on offer from Turkey and Russia.

The London price of Rhodesian metallurgical 48 per cent was raised in July, 1957 from £17 8s. 0d. per l.ton c.i.f. to £19 5s. 0d. and reduced to £17 5s. 0d. on January 1, 1958. On the open market, the general trend was fairly consistently downwards.

During 1957, Turkey exported chrome ore worth about £T63,000,000. The barter of Turkish chrome ore for U.S. agriculture surpluses was finally completed in June and involved about $10,000,000 worth of ore. In February, 1958, it was reported that Turkey had agreed to supply 150,000 tonnes of chrome ore worth about $5,000,000 to the U.S.

Turkey's Maden Kredi Bankasi (Mineral Credit Bank) started operations early in 1958 and immediately called into being a chrome production company under the name of Krom-Ischletmesi AO to represent, within the Bank, the interests of chrome mine owners. Credits will be granted mainly to improve export possibilities for Turkish chrome by reducing mine exploration costs.

In 1957, the production of chrome ore in Southern Rhodesia rose to 654,076 l.tons compared with 399,634 tons in all 1956. The increase is attributed to the improved truck allocation position, which led to rapid clearing of the stockpile and allowed small truck allocations to be given to new producers. Great activity is being shown along the Great Dyke where interested parties include several of the larger houses who have not previously concerned themselves with chrome. However, due to the state of the chrome market, the Rhodesian

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Vanadium Corporation has temporarily suspended production at its Spots Chrome mine between Selukwe and Shabani, which had been producing 2,000 tons of ore monthly.

Production in the Union of South Africa increased to 736,616 s.tons from 691,905 tons in 1956. It has been forecast that chrome railings for 1957-58 will probably remain between 500,000 and 600,000 tons, with an improvement during 1958-59 and a sharp rise during 1959-60 dependent on the handling capacity of Lourenco Marques harbour. The S.A. Mineral Corporation has closed down its chrome ore mine in the Rustenburg area of the Transvaal until the market improves.

Production of Cuban refractory grade lump chrome ore in the Moa Bay district of Oriente Province declined from 80,000 s.tons in 1956 to 60,000 tons in 1957. However, as a result of development work and opening up of new deposits by Minera Moa, S.A. and Compañia Cayo del Medio, S.A. an upturn in the rate of production of this high-grade chromite is now expected.

Shipments of chrome ore from the Philippines during 1957 at 700,879 l.tons, remained at approximately the same level as in 1956. The year's production comprised 602,490 l.tons of refractory and 111,568 l. tons of metallurgical ore.

In 1957, the U.S. consumed 1,760,469 s.tons of chromite against 1,846,600 tons in 1956. Domestic mine production totalled 164,746 (207,662) and imports 2,372,044 tons (2,175,056). Industry stocks of chromite ore and concentrate increased by 32 per cent during the year. The U.S. General Services Administration announced in January, 1958, that it had completed all buying programmes for metallurgical, chemical and refractory grade chromite.

The U.K. Board of Trade made five releases of chrome ore from its strategic stocks during 1957 totalling about 80,000 tons. In February, it released about 650 tons of low-carbon ferro-chrome.

Chrome ore supplies generally appear to be fully adequate for current demand and it is difficult to envisage any recovery in prices until conditions change.

COBALT

SINCE an abundant supply of cobalt is now available for civilian uses, the price of this metal which had been stable since 1953 was reduced from $2.6 to $2.35 in 1956 and further to $2 per lb. on February 1, 1957. In Britain the price was correspondingly reduced in two stages from 21s. to 16s. per lb. These reductions which, as it is expected will stimulate demand, have been favoured by technical improvement which resulted in lower manufacturing cost.

Production

The mining companies announce increasing figures every year, as they keep investigating the known orebodies and prospecting wide areas for new deposits. The reserves of recoverable cobalt are sufficient to warrant production at the present rate for another eighty years.

Most of the world's cobalt supply is a co-product from the processing of copper-cobalt and nickel-cobalt ores. Since the cobalt ratio of these ores varies within wide limits, the cobalt production can rather easily be adapted to the fluctuations of consumption through a careful choice of the ores to be processed. The producers are thus in a flexible position to respond rapidly to a rising trend in world consumption of cobalt.

On the other hand, production capacity will be increased by some 7,000 s.tons within a few years, thanks to the new plants or plant extensions of Sherritt Gordon Mines Ltd. (production started in 1956), Chibuluma Mines Ltd. (1957), Metallurgical Resources Ltd. (1958), Freeport Sulphur Co. (1959), Union Minière du Haut-Katanga (1960) and Kilembe Mines Ltd., in Uganda.

Our production statistics (table 1) take into account not only the direct mine output, but also production from scrap and residues of pyrite roasting. The 1957 production figure is estimated.

Consumption and Uses

While consumption is showing a small decrease in the United States (table 2), the world total consumption of cobalt is steadily increasing.

The technical future of cobalt seems to lie more than ever in the high temperature alloy field. Expansion of cobalt alloys is expected in uses where thermal shock, hot wear, hot hardness and non-galling properties are requested.

A 65 per cent cobalt-alloy for turbine blades was developed by the Westingham Research Laboratories. Utica Drop Forge and Tool Company presented a new cobalt-base alloy produced by vacuum melting. General Electric's Jetalloy 1570 is now used for power generation in gas turbines at 1,570 deg. F. Another cobalt-base alloy can be improved by a boron addition in order to be used up to 1,800 deg. F.

New cobalt-base alloys are being developed in France and England, while the different grades of "Stellites" show their outstanding qualities in a great number of countries and in a variety of applications.

In the magnet field the use of Alnico alloys is steadily extending. In the next year stiff competition to Alnico 5 may be presented by a new fine particle iron material, but it will probably be superseded by a fine particle 40 per cent cobalt alloy that is at present being investigated.

Table 1

FREE WORLD COBALT PRODUCTION

(s.tons of Contained Cobalt)

Country	1955	1956	**1957**
Belgian Congo	9,443	10,019	**9,029**
Canada	1,650	1,769	**1,868**
United States	946	1,400	**1,625** est.
N. Rhodesia	871	1,271	**1,566**
Germany (a)	1,093	1,031	**1,082**
Morocco (b)	834	716	**720** est.
Others (c)	63	94	**110** est.
Total	14,900	16,300	**16,000** est.

(a) from pyrites mined in Finland and from scrap.
(b) cobalt content of concentrate. Metal output somewhat smaller.
(c) including Australia, Mexico, Japan and others.

Table 2

COBALT CONSUMPTION IN THE UNITED STATES

according to the Bureau of Mines

(s.tons of Contained Cobalt)

1955	4,870
1956	4,781
1957	**4,630** est.

Cobalt is irreplaceable in the field of magnets operating at variable temperatures, for which there is an increasing demand for precision instruments.

The use of cobalt for electroplating has not been fully exploited. A number of companies have manufactured bright nitrate-cobalt deposits showing outstanding wear and corrosion resistance; this application may be largely extended.

The use of cobalt as a catalyst is steadily increasing, while the metal's market in driers and other non-metallic compounds is holding its own.

Research

A great number of researches in relation to cobalt have recently been undertaken and it is expected that important credits will be devoted to the same purpose within the next few years.

The newly created Centre d'Information du Cobalt is sponsoring a great number of studies, some of which are of fundamental character.

This organization, which has its head office in Brussels (35, rue des Colonies), intends to open several branches in the main cobalt consuming countries. An American branch is already in operation in Columbus (Ohio) within the Battelle Memorial Institute.

On the other hand, many cobalt producers are doing research work in their own laboratories and the U.S. Government Agencies have sponsored during the last few years over 150 studies on cobalt alloys, mainly for aircraft applications.

TUNGSTEN

TUNGSTEN, the metal with the highest melting point, namely, 3,410 deg. C., is also extremely hard and highly resistant to corrosion. Its chief outlet is in the steel industry for the production of high-speed steels. Other applications are in corrosion and wear-resistant alloys and in the production of cement carbides. Demand depends primarily on the level of steel production.

During World War II and again during the Korean War demand and prices soared. The stimulus of high prices led to over-supply, which was accentuated in 1957 by the near completion of U.S. Government contracts with foreign producers, by the cessation of the U.S. domestic purchasing programme, and by the resumption of shipments of high grade ore from Korea. The consequence has been a steady decline in the price of tungsten ores. On January 2, 1958, wolfram and scheelite (65 per cent) were quoted in London at 92s. 6d./100s. per unit c.i.f., compared with 220s./225s. in January, 1957, and 272s./276s. in January,

1956. After a further decline to 90s./96s., a firmer tendency became apparent early in 1958, but the market again weakened and by April 16, quotations had declined to 85s./88s.

China has the largest and richest deposits of tungsten minerals in the world, but tungsten also occurs elsewhere in Asia—notably Burma, Malaya and Japan—and in every other Continent. In 1956 world production reached the peak total of 40,100 l.tons, but last year the decline in prices and demand caused many high-cost producers to suspend or curtail operations. It now seems unlikely that the Free World is over-producing tungsten ores, though it is probably still over-stocked.

By far the largest consumer and importer of tungsten ores is the U.S., which is also a large producer. In Jan.-Sept., 1957, the U.S. consumed over 4,000 s.tons of tungsten ore (contained tungsten), which compares with 4,530 s.tons in 1956. U.S. domestic mine production totalled 3,774 tons against 7,380 tons in 1956. General imports during 1957 fell to 7,500 s.tons from 10,928 s.tons in 1956. At the end of 1957, stocks stood at 4,000 s.tons as against 2,228 tons at the end of 1956.

Due to the disparity in world and domestic prices and to the end of the Government purchase programme, almost all U.S. domestic tungsten mines are now cut down. The tungsten purchasing programme, which was put into effect in 1950, increased domestic production within two years by 50 per cent, while at the same time imports of tungsten quadrupled. The U.S. supply of tungsten is reported to be sufficient to cover five years of wartime needs.

In January, 1958, Government approval was given to an agreement between the State-owned Taehan Tungsten Corporation and the Continental Ore Corporation, New York, giving the U.S. company exclusive rights for handling the sale of Korean tungsten for one year. Continental Ore will purchase 4,200 tons of ore annually from the Taehan Corporation at $11 per unit, price being subject to negotiation if the world market price changes substantially. During 1957 the Taehan Corporation produced 3,800 tons.

Portugal is still mining wolfram, but at a loss. Production in Jan.-Aug., 1957 amounted to 2,417 tonnes against 2,606 tonnes in the corresponding period of 1956. Producers are concentrating on the better sections in the mines. Exports at 2,786 tonnes were about 50 per cent lower than in 1956. Spanish wolfram ore exports have been exempted from taxes, but so far no action of a similar nature has been taken by Portugal.

The recovery of the tungsten market depends largely on the duration of the U.S. recession and resumption of the upward trend of steel production. Demand should be stimulated by new developments in high temperature alloys for jet engines and guided missiles.

Now that over-production has probably been eliminated, present indications point to a period of comparative stability at prices above the worst. Bearing in mind that production cannot be switched on and off, however, it is not inconceivable that in the event of a sudden upturn in demand, the tungsten pendulum might even swing sharply towards a sellers' market.

MOLYBDENUM

MOLYBDENUM imparts increased strength and hardness, as well as resistance to heat and corrosion, to high speed tool steels, high temperature alloys and stainless steels. Its prospects are particularly encouraging in the high temperature field. Molybdenum base alloys have higher useful strength at over 1,600 deg. F. than any other known materials. It has been reported that molybdenum can now be used at working temperatures exceeding 2,000 deg. F. The salts of molybdenum find uses in fertilisers, paint pigments, welding rod coatings, and in the chemical field. Molybdenite is being increasingly used for lubricants.

The U.S. produces about 90 per cent of the world molybdenum output, the Climax Molybdenum Co. being responsible for some 66 per cent of the U.S. production. The Climax mine is the world's major source of primary molybdenum, the balance coming as a by-product from copper mining. In December, 1957, a merger of the American Metal Co. Ltd. and Climax Molybdenum Co. into American Metal Climax Inc. was approved by shareholders of both companies.

Early in 1956 molybdenum supplies from Chile declined and Climax Molybdenum was called upon to provide a growing proportion of the world's needs. Under the pressure of rising world demand, together with some difficulty in maintaining the level of output at Climax, a shortage of molybdenum arose in 1957. In May it was announced that Climax proposed to stop shipments of molybdenite to Europe in order to deliver molybdic oxide to its

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European customers in accordance with its practice in the U.S. The changeover was postponed as a result of a strike at Climax's Langeloth treatment plant, which lasted for five months.

One effect of the shortage was the appearance on the market of molybdenite from certain unconventional sources, notably some American copper mines.

During 1957, U.S. concentrate production was 30,000 s.tons and consumption 15,500 tons, compared with a production of 28,731 s.tons and consumption of 21,326 tons in 1956.

Chile produced 2,709s. dry tons of molybdenum concentrates in 1956. The Braden Copper Co. has been Chile's only producer, but the Chile Exploration Co. recently set up a molybdenite recovery plant at Chuquicamata, which is now in production.

Canada ranks third in the list of Canadian producers. All the Dominion's production comes from the Molybdenite Corporation of Canada, some 25 miles north-west of Val d'Or, North-Western Quebec. This company now converts its output to molybdic trioxide.

Rio Canadian Exploration, the exploration subsidiary of Rio Tinto Mining Co. of Canada, is reported to be obtaining very favourable results from its molybdenite prospect in the Echo Lake area of North-Western Ontario.

A deposit of molybdenite has been discovered near Selukwe, Southern Rhodesia, where R.S.T. Exploration Ltd. has been engaged in preliminary exploration.

With increasing markets and limited world production capacity, the outlook for molybdenum producers remains favourable. Despite some levelling off in 1957, total Free World industrial consumption continues at high levels. Customers' inventories are low. With full production at Climax and with a new supply from Anaconda's El Salvador mine in Chile, scheduled to come into the market in the fairly new future, consumers should be able to count on a satisfactory supply position.

VANADIUM

VANADIUM'S principal field of application is in the manufacture of steel alloys to impart hardness, toughness and resistance to heat. Because of its high melting point (1,725 deg. C.) vanadium is of importance in the construction of high-speed jet aircraft. It is also used as a fuel element cladding for fast reactors, where interdiffusion, hot strength and thermal conductivity are considerations.

The year 1957 witnessed a notable change in the pattern of the Free World's vanadium industry. During the year control of the Adenab West mine, owned by the South-West Africa Co., was acquired by a British mining group comprising New Consolidated Goldfields, Anglo American Corporation of South Africa, and the British South Africa Co.

Later in the year vanadium production from magnetic lenses in the Bushveld complex was started in the Transvaal by Minerals Engineering Co. South Africa (Pty.) Ltd. In association with Rockefeller Centre Inc. and High Speed Steel Alloys Ltd., of the U.K., this company has set up a capacity of 1,800 s.tons of vanadium concentrates annually. Most European buyers are now looking to this new mine for at least part of their supplies. Preliminary investigation suggests that deposits in the Transvaal may exceed any other known sources in the Western world.

Another new source of supply has arisen through the start of uranium production in the Colorado plateau, U.S.A., from which large quantities of by-product vanadium ore have become available.

The U.S. continues to be the largest producer and consumer of vanadium. No statistics of production are available, but in 1957, U.S. consumption totalled 1,789 s.tons, being some 10 per cent lower than in the previous year.

COLUMBIUM and TANTALUM

By R. Bruce Dunfield

PRODUCERS of columbite—and that particularly applies to Nigeria which supplies about 90 per cent of the world's requirements — are in a curious position.

The market for columbite turned weak and has remained featureless since May, 1955, following the announcement that the U.S. Government would discontinue purchasing columbite from non-domestic sources for the stockpile. Yet since that time there has been a constant stream of articles in the technical press and symposia on both sides of the Atlantic forecasting a bright future for the metal in nuclear energy programmes, in rockets, in guided missiles and, in fact, in applications wherever metals are required to withstand temperatures of 1,500 deg. F. and above.

Thus, on the one hand, there is the picture of established producers cutting back production and compelled to find buyers wherever they can and, on the other, a keen scramble by the 'have not' countries to discover deposits and to develop processes for the production of the metal in a high purity form.

This may be taken as positive proof of the belief in the bright future for the metal, but it is small consolation to producers who are at present faced with a market price of around £640 per s.ton for 70 per cent joint pentoxide concentrate. Moreover, buyers are scarce and stocks held in Nigeria and in the U.S. ensure prompt delivery. Under these conditions the output of columbite in Nigeria in 1957 dropped for the second year in succession, the output figure of 1,923 l.tons comparing with 2,604 l.tons in 1956 and the peak production of 3,150 l.tons achieved in 1955.

When the present uncertain state of the market will take on a firmer appearance is hard to judge. That it will, however, seems certain. In the field of atomic energy columbium was selected as the "canning" material for the Dounreay fast breeder experimental reactor. Murex Ltd. are erecting a new plant at Rainham, Essex, for the production of pure tantalum and columbium powders to come into operation in 1959. Sir Arthur Smout, chairman of Murex, in his statement to shareholders last year stated that columbium "appears to have great possibilities for those engine components which are subject to stress at high temperatures."

This important aspect forming the heralded bright future for the metal is being pushed ahead in the U.S. with all possible speed and at considerable expense. Du Pont has developed columbium metal and columbium alloys possessing high strength at high temperatures to help solve critical design problems in jet engines, guided missiles, and atomic reactors. Westinghouse has announced the production of ultra-high purity metal by "cage zone melting" and considers that columbium may well emerge as a valuable structural metal of the future. Electro Metallurgical Co. have made high purity columbium available commercially, and the Fansteel Metallurgical Corporation are producing the metal in the form of sheet, rod and seamless or welded tubing. Kawecki Chemical Co. and Kennametal Inc. are also producing the metal. While many new uses are classified, it would appear that the metal has an important role to play in the construction of turbine buckets, jet engine burner tunnels, in skins for supersonic missiles and in ram-jet tail pipes.

It is not altogether surprising, therefore, that despite the poor state of the columbite market at present, countries are searching for new deposits. In Canada where columbium has been discovered in pyrochlore ores a successful process for separating the columbite has yet to be found, although good progress is being made in this direction. In Tanganyika a pilot mill of 150 t.p.d. capacity has come into operation at the Mbeya pyrochlore deposits to provide information for the design of a final production mill capable of treating several thousand tons of ore daily. Metallurgical tests indicate that columbium concentrates can be produced without difficulty. Elsewhere, the Anglo American Corporation of South Africa are investigating the possibilities of producing columbium from limestone in Northern Rhodesia and from a rare earth deposit known as the Mrina Hill deposit in Kenya.

In the U.S., although production increased in 1956 by no less than 117 per cent, the total output only amounted to 106 tons of concentrates.

Summing up it would seem that columbium has temporarily outrun its market but that its day is coming and all signs point to it being sooner than many believe now to be the case. Improved sales of columbite concentrate are anticipated due to assured availability, which has instilled confidence in potential users, as well as to a growing preference for columbium-stabilized stainless steel and the wider employment of columbium where high temperatures are essential.

Tantalite is in keen demand and is being eagerly sought from the very limited sources of supply. Apart from the expansion of the conventional applications in the chemical and electronic industries and in surgery, the metal is also of particular importance in certain atomic reactor designs.

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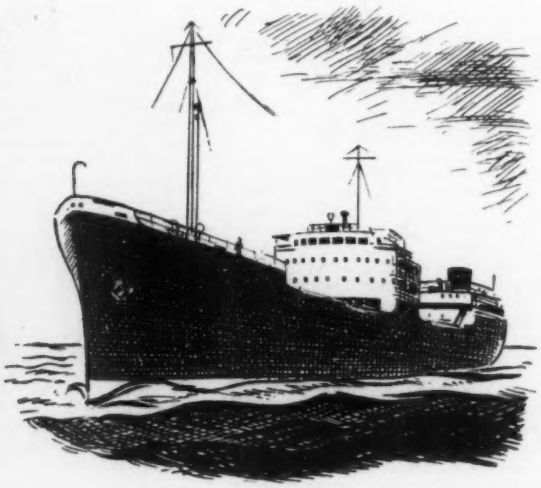

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The Electronics Metals and Minerals

CADMIUM • SELENIUM • SILICON • GERMANIUM • INDIUM
MICA • RHENIUM • GALLIUM

CADMIUM *By Paul E. Grainger*

CADMIUM followed the same general pattern in 1957 as most of the major base metals. Production has been rising steadily since the war in response to rapidly growing consumption. It reached a peak around mid-year when a slight slackening in demand brought rapid easing of the supply position resulting in rising stocks and lower prices towards the end of the year.

World production of cadmium metal rose 2½ per cent in 1957 and totalled about 8,720 l.tons. Over half of this was produced in the U.S.A., from domestic and foreign zinc ores and from cadmium-bearing flue dusts obtained from Mexico. Imports of flue dusts rose 7 per cent during the year to 775 l.tons (Cd content) but metal production at 4,705 l.tons was 1 per cent less than in 1956. The main producers outside the U.S.A. were Canada 901 l.tons, Belgium 660e, Australia 393, Japan 352, Belgian Congo 300e and Germany 273. Production in Poland and the U.S.S.R. was estimated to be about 250 tons and 150 tons respectively.

U.S. apparent consumption of domestic and imported metal was 4,970 l.tons, 12 per cent below 1956, but still the second highest of any post-war year. Electro-plating, pigment manufacture, silver-brazing and tube-bending alloys were the main uses. Stocks at U.S. producers and distributors stood at 1,607 l.tons at the end of 1957 compared with 1,496 l.tons at end 1956.

Consumption in the U.K. rose 5 per cent to 962 tons, 4 tons only below the record of 1955. Electro-plating remained the main outlet in the radio, aircraft, automobile and engineering industries and took 594 tons against 543 tons in 1956. 172 tons were used in pigment manufacture compared with 140 tons in 1956. Batteries, cadmium-copper, solder and other alloys used less than in the previous year. U.K. imports at 953 tons, exports at 110 tons and end-year stocks at 264 all reached new post-war heights. Imports included 358 tons from Canada, 270 tons U.S.A., 180 tons Australia and 91 tons Belgium, but towards the end of the year Polish and Japanese cadmium was being offered and the first small imports were made. In January, 1958, the U.K. Board of Trade announced the intended disposal of 12½ tons, representing the final balance of the cadmium stockpile. This was for sale by open tender and delivery before the end of March.

In December, the U.S. selling price was cut from $1.70 to $1.55 per lb., delivered in 1 to 5-ton lots, as the result of severe competition from abroad. In September, the U.K. price was reduced from 12s. to 11s. 3d. per lb. for 1 cwt. lots and in January, 1958, there was a second reduction to 10s. per lb.

Cadmium's main use—electro-plating—arises from its outstanding resistance to corrosion, but it has a variety of other uses in alloys and as a base for pigments. Several new applications were developed in the U.S.A. during 1957 according to reports of the U.S. Bureau of Mines. A new type 1.2 v. nickel-cadmium sintered-plate battery was introduced for use in miniature electronic apparatus and a method of vacuum deposition of cadmium on steel parts was developed which eliminates hydrogen embrittlement, requires no electric current and is conducted at room temperatures.

Cadmium is also used as a control material for nuclear reactors, but it has the disadvantage of low melting point and of being ineffective for neutrons in certain energy ranges. However, it was believed that if the new Dounreay-type reactor proves successful the use of cadmium would be extended, though the quantities involved are comparatively small and non-recurring.

The outlook for cadmium remains rather weak. Much will depend on the level of zinc mining in the U.S.A. and other countries, for being a by-product, cadmium production rates are not susceptible to rapid adjustment. Demand does not appear likely to improve in the near future and being an expensive metal consumers tend to work with minimum stocks.

SELENIUM

SELENIUM is derived mainly as a by-product from the electrolytic refining of blister copper. The largest producers are the U.S. and Canada, but there is also a limited production in Northern Rhodesia, Australia, Mexico, Japan and various European countries.

The electronics industry uses selenium of semi-conductor grade in the production of rectifiers. Other important applications are in the form of cadmium-sulpho-selenide pigments in the paint, plastics and rubber industries. Selenium is also used in photo-electric cells and in the manufacture of coloured glassware.

After having been extremely scarce, selenium became much more plentiful during 1956, due to rising production, to the introduction of successful measures for recovering the metal from scrap, and possibly also to the more extensive use of germanium and silicon in electronics. As a result of the changed situation, the price to U.K. consumers of Canadian selenium of 99.5 per cent grade was reduced at the beginning of 1957 from 112s. to 85s. per lb. By that time prices of non-Canadian selenium had fallen to approximately the latter level.

During 1957 North American production remained high and there were also increasing offerings from Western Germany and other sources, including Japanese metal at very cheap prices. Competition from germanium was possibly another factor in bringing about a further reduction in the price of Canadian metal, the U.K. domestic price being lowered in May to 75s. per lb. By the end of the year a further reduction took place to 53s. 6d. per lb. On February 19, 1958, the price was again brought down, this time to 50s. per lb., following an equivalent cut in Noranda selenium in Canada from $7.50 to $7 per lb. for the common grade and from $10.50 to $9.50 for high purity grade. In the U.S. the American Smelting and Refining Co. announced reductions in its charges to similar levels.

United States production of selenium in 1957 was estimated at 525 s.tons, compared with a record 558 s.tons in 1956. Canada produced 176 tons in 1957 against 165 tons in the previous year.

While it remains to be seen how far world production of selenium will be affected by cut-backs in copper production, the present state of the market and the uncertain economic outlook seem to discount the likelihood of any renewed shortage in the short-term future.

SILICON

SILICON, which is produced from one of the earth's most abundant raw materials, sand, is finding large-scale use as a semi-conductor in transistors and rectifiers for highly sensitive electronic devices. Silicon is also used for solar cells to take energy from the sun. The steel industry is a consumer of this metal in the form of ferrosilicon.

Silicon of semi-conductor grade was introduced in the U.S. by Du Pont in 1952 at $430 per lb., but substantial price reductions have since been made. In November, 1957, further reductions of up to 25 per cent on semi-conductor grade silicon material were announced in the U.S. The price of standard grade was reduced from $320 to $240 per lb., that of premium grade from $500 to $400, and that of research grade from $980 to $750.

In July, 1957, W. R. Grace & Co., of New York and Péchiney, of France, announced the formation of a new company in the U.S. to produce high-purity elemental silicon and other semi-conductors. The plant was scheduled to start operation about

mid-1958 with an annual capacity reaching 20,000 lb. Péchiney is already producing highly purified silicon in France. In February, 1958, a $3,000,000 plant for the production of silicon and ferro-silicon was started at Powhatan Point, Ohio, by the Ohio Ferroalloys Corporation.

In the U.K. methods of producing high-purity silicon on a reasonable commercial scale have been developed by Imperial Chemical Industries Ltd. and during 1957 the construction of a pilot plant was begun.

Silicon is still much more costly than germanium, but the abundance of raw materials and its performance at temperatures 100 deg. C. higher than germanium can withstand make it a leading competitor for the rapidly expanding electronics market. It has been forecast that the price of transistor grade silicon should fall to $150 per lb. by 1960 and well below $100 per lb. five years later. According to Dr. Robert S. Aries, of Aries Laboratory, New York, U.S. consumption was expected to rise from 10,000 lb. in 1956 to 20,000 lb. in 1957 and a projected 90,000 lb. in 1960. Considerable potentials have also been uncovered for lower grades of silicon, including about 20,000 lb. of solar grade around 1960.

GERMANIUM

GERMANIUM is normally recovered from zinc ores and from the flue dust at zinc smelting plants. In the U.K. it is being recovered economically from flue dusts resulting from the carbonization of coal, the producer of this form of germanium being Johnson, Matthey & Co. Ltd.

Pure germanium is used in the electronics industry for the rectification of microwaves and in the manufacture of transistors and diodes. Germanium dioxide is used in special phosphors and electronic applications.

The spectacular growth of the semi-conductor industry continues. In the U.S. sales of transistors and semi-conductors were expected to reach a total value of $125,000,000 in 1957. Germanium and silicon are at present the two main semi-conductor materials of importance. Now that the pattern of consumption is becoming slightly clearer, it appears that germanium is likely to find its largest field of applications in transistors, but might give ground to silicon-based units in the rectifier use.

In Africa germanium is recovered as a by-product by both Union Minière and the Tsumeb Corporation. Belgian Congo exports of germanium ore amounted in 1957 to 228 tonnes compared with 244 tonnes in 1956. Union Minière has been producing germanium in increasing quantities from the furnace dusts of Lubumbashi. These dusts are treated by a special section of Metalkat, which in turn sends a germanium concentrate to Hoboken, where oxide and metal are produced. During 1957, a plant was installed at Kipushi for the recovery of renierite (germanium sulphide) present in Prince Leopold mine ore. At Antwerp Soc. Metallurgique de Hoboken has been engaged on an expansion programme designed to raise output of germanium dioxide to about 34,000 kilos a year.

Belgium is virtually the only overseas supplier of germanium to the U.K. Rising production and efficiency have led to reductions in price, the quotation for 99.99 per cent germanium of Belgium origin falling in February, 1958, to 2s. 8d. per gram from 3s. 4d. at the beginning of 1957.

INDIUM

WORK on indium started in 1924, when Dr. William S. Murray, now president of the Indium Corporation of America, was working with Oneida Ltd. as director of research. Though still relatively little known, this metal is becoming increasingly available commercially and is finding a widening field of applications.

The principal uses of indium are for surface protection, hardening and decorative finishes, and in electronics. The addition of small quantities in alloying imparts hardness and strength to other metals and increases resistance to tarnish or corrosion. Indium-treated bearings are now extensively used, particularly in aviation. Other uses are in the low-melting point alloys, glass-sealing alloys and certain dental and solder alloys. There are also certain Government uses of a secret nature.

The world output is derived as a by-product, mainly from the treatment of zinc blends, the chief sources being the U.S. and Canada. The largest U.S. producers are the Anaconda Co., who produce this metal for the Indium Corporation of America. The latter undertaking is the only company in the U.S. whose sole business is the continued research and development of new uses for indium and the fabrication of the metal into various products. In recent years, the American Smelting and Refining Co. has also been a substantial producer of indium.

In Canada indium is recovered at Trail, British Columbia, by the Consolidated Mining and Smelting Co., the ore from which it is derived coming mainly from the Sullivan lead-zinc-silver mine at Kimberley. In late 1957, Cominco closed the Sullivan open pit and curtailed zinc output. The recovery of by-product indium is therefore likely to have fallen slightly below the 1956 output of 358,000 oz.

Indium is also refined in Germany Belgium, Italy Peru, Japan and probably the U.S.S.R. A plant for the extraction of scarce metals including indium, is being set up in Muldezhuetten, near Freiberg, East Germany.

MICA

MICA is used in industry either in sheet or in ground or powdered form. About 90 per cent of the sheet mica production is consumed in the electrical industry. High quality natural mica, which has always been scarce, is the only known material satisfactory for use in certain essential electronics products, such as tubes and capacitators.

World production of mica fell in 1956 to 110,000 l.tons from 116,000 tons in the previous year.

A total of 909 s.tons of block and film mica was fabricated in the U.S. during the first half of 1957. This was 2 per cent less than in the last half of 1956 and 26 per cent less than in the first half of 1956. Electronic applications consumed approximately 96 per cent of the stained and better qualities of muscovite block and mica film fabricated. Capacitors accounted for 87 per cent of the good stained or better mica going to electronic use. Consumption of phlogopite block mica—27 per cent greater than in the last half of 1956 and 98 per cent greater than in the first half of 1956—was entirely for non-electronic applications.

India is the world's largest exporter of mica, shipments of all grades in 1956 totalling 24,233 l.tons. In the first half of 1957 they amounted to 14,099 tons.

The number of active mica mines in South India dwindled from 144 in 1951 to 40 in 1957, the reason given being that the U.S., which had been the biggest consumer of the various categories, has not been importing on a large scale since the Korean War. The Government of India and the State Governments are being urged by producers to start electrical industries to consume the bulk of the mica produced. The National Council of Applied Economic Research has recommended the establishment in India of a mica wet grinding plant with an initial capacity of 1,000 tons per year, which would enable India to market mica in ground form.

On April 17, 1957, the Andhra Pradesh Legislative Assembly passed a Bill which provides for a system of licences for controlling the possession and the sale of mica and a system of permits for controlling its removal and transport.

The U.S. mica purchasing depot purchased mica to the value of $3,000,000 in 1956 and expected that the total for 1957 would show an increase of approximately 25 per cent.

RHENIUM

THE rare metal rhenium is likely to be of growing importance in the electric and electronic industries as a result of new developments in processes for its fabrication. Rhenium may soon be used in electrical contacts and electron tube materials. Other potential uses are seen in high-temperature thermocouples and high-wear-resistant parts such as thermocouples.

Rhenium occurs in a wide variety of minerals, but in very minor amounts. At the present time the only known commercial source is a fluedust resulting from the roasting of an Arizona molybdenite originating from copper sulphide ore. In its purest form rhenium now sells in the U.S. for about $3.80 to $4.00 per gram.

Rhenium was recently found in deep layers of copper ores in the Jezkazgan deposits in central Kazakhstan, U.S.S.R.

GALLIUM

GALLIUM will melt from the heat of a man's hand, but will not boil until heated to about 3,600 deg. F. Unlike most elements it expands when it solidifies.

Gallium arsenide and gallium phosphide have demonstrated interesting properties for use in transistors, diodes, rectifiers and other semi-conductor devices. These compounds are being used in new transistors and diodes said to be capable of operating at temperatures nearly 300 deg. F. hotter than the maximum for existing types.

Refinements in the processing method have enabled the Aluminum Co. of America to produce gallium of better than 99.995 per cent purity.

The Nuclear Metals

URANIUM • THORIUM, THE LANTHENONS AND YTTRIUM

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URANIUM *from a Special Correspondent*

PRODUCTION of uranium oxide in the Free World increased to approximately 22,000 tons last year but the industry entered 1958 forewarned of problems ahead.

The past year was by no means an uneventful one for the industry, and particularly was this so in the U.S.A. where in October came the A.E.C. statement that further expansion of uranium production beyond the present programme was considered undesirable from the standpoint of the Government and the industry.

The A.E.C. announcement signalled the virtual retirement of the small prospector from the search for uranium in the U.S., and has led to serious reappraisal of their exploration policy by larger operators. At the same time American uranium ore reserves are small in relation to milling capacity and there is obvious need for a device to encourage the discovery of new deposits without the commitment to construct new mills. One suggestion is that a uranium ore stockpile be created, or rather, that the existing two million ton stockpile be increased.

Exploration

Elsewhere in the world exploration for uranium has continued and there have been reports of new finds from many countries. However, no new major field appears to have been located, preliminary reports of a vast find in South-West Africa being unconfirmed. A very high grade find of uranium was made during 1957 in Labrador. The deposit now being developed by the British Newfoundland Corporation is over 1,000 feet long with an average width of six feet. The uranium content averages 0.75 per cent and production is envisaged at a rate of 200 tons of ore daily. In New Zealand the Buller Gorge deposits continued to receive attention and a comprehensive diamond drilling programme is planned. The deposits are thought to contain over 20,000,000 tons of ore with a grade of at least 2 lbs. U_3O_8 per ton. A possible production of 500 to 750 tons of concentrate a year has been envisaged.

Production

South African uranium output reached 5,700 tons U_3O_8 in 1957. During the year the seventeenth uranium treatment plant at Buffelsfontein was commissioned, bringing the Union's total uranium-milling capacity to 1,750,000 tons of ore per month. On completion of this plant it was announced that it marked the end of the Combined Development Agency programme in South Africa. Since the programme's target has never been revealed this caused some surprise, but that the C.D.A. meant what it said was emphasized later in the year when Klerksdorp Consolidated's application for consideration as a producer was refused.

Buffelsfontein has recently offered to expand its uranium production capacity at its own expense; as the year ended, discussions on further expansions were taking place between the C.D.A. and the Union Government.

Canadian uranium production totalled 6,438 tons of concentrates during 1957 and 14 mills were in operation at the year's end. However, over a third of 1957 production was from the two 3,000 tons per day Nordic and Quirke mills of Algom Uranium Mines in the Blind River district, which were operating at capacity. Consolidated Dennison's 6,000 tons per day mill experienced operational difficulties and was operating at only two-thirds capacity. Running costs were consequently high and estimated capital expenditure has been exceeded by $5,000,000. Capital expenditure estimates for Blind River mines have frequently proved too low and during the year Northspan arranged additional finance to complete the three mills it is building in this field. By May 1958, when Millikan Lakes comes into production, there will be 11 mills in operation at Blind River with a combined throughput of 45,000 tons of ore daily.

Both Canadian and American estimated reserves of uranium ore were sharply increased during 1957, although the United States with its 727 mines supplying ore to the mills is in a vastly different position to the two other major producing centres of the West. With higher grade ores the U.S.A. was the principal producer despite her lower milling capacity, 1957 deliveries of concentrate to the A.E.C. depôt at Grand Junction totalling 8,494 tons U_3O_8. By the end of 1959 24 treatment plants are scheduled to be in operation, of which 16 had been completed at the close of 1957.

Following the declassification of information on uranium production by the three major producers Australia released output figures for her Rum Jungle and Radium Hill mines, whose statistical year ended in June. In the twelve months Rum Jungle produced 271 tons of concentrate from ore carrying 9 lbs. U_3O_8 per ton and 2.5 per cent copper. Ore reserves total 197,000 tons with a uranium content of 6 lbs. per ton. Radium Hill's output of concentrate was 225 tons. Construction of the mill at the Mary Kathleen mine is reported to be ahead of schedule. £A.10,000,000 has been spent on construction at Mary Kathleen and 40,000 feet of diamond drilling carried out. Commencement of production during 1958 will raise Australia's concentrate output to 1,000 tons annually.

The Australian uranium industry had an eventful year. New ore discoveries were reported at Radium Hill and at Rum Jungle plans were being made for the exploitation of a new orebody close by the original mine. United Uranium converted the Northern Hercules gold treatment plant to beneficiate ore from its El Sharana mine at a rate of 30,000 tons per annum. North Australian Uranium Corporation N.L. after a period of uneconomic working discontinued operations at its Adelaide River mine in the Northern Territory, sold off the equipment, and surrendered its mineral leases. Subsequently 2,250,000 shares in this concern purchased by Atlas Corporation of America in 1955 were sold to Aberfoyle Tin N.L. Australian Oil Exploration which holds a 35 per cent interest in Mary Kathleen has met with no success in its own uranium ventures, and at the end of the year, reorganization of the company's activities was under discussion. Paringa Mining and Exploration acquired the Milo group of leases in the Cloncurry field.

The Belgian Congo is still reticent about uranium production in the territory. The Shinkolobwe plant is apparently treating 25,000 tons of ore per month and as the Congo ores are known to be high grade, an estimated concentrate production of 1,000 tons annually does not look unreasonable.

Elsewhere in Africa a small uranium production was made from the Mindola section of the N'Kana mine and deposits were under examination in Nyasaland and Southern Rhodesia. However, plans for a central processing plant in Southern Rhodesia have been shelved.

Reserves of 3,000,000 tons of ore carrying 4 lbs. U_3O_8 per ton have been established in Italy and an ultimate annual output of 350 tons U_3O_8 has been forecast. Production facilities at present planned have a capacity of only one-fifth of this figure.

France has uranium ore treatment plants in operation or under construction at Gueugnon, Ecarpière and Bessines, and has established reserves sufficient to maintain her nuclear development programme. Production during 1957 has been estimated at over 300 tons U_3O_8. Concentrate production is to be steadily increased to 1,000 tons U_3O_8 annually by 1961.

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in Brazil where ores carrying 4 lbs. U_3O_8 per ton have been located and exploration speeded up. News of economic grade uranium ore discovered also came from Peru and Chile, whilst Argentine introduced mining legislation designed to encourage prospecting for radioactive ores.

Uranium output in Portugal has still not been revealed but the Portuguese offer of over 100 tons U_3O_8 to the International Atomic Energy Agency might be taken to indicate a well-established industry. The largest producer is understood to be the Urgeirica mine operated by the Companhia Portuguesa de Radium.

Discoveries of radioactive ores in Greenland, Fiji, Japan, Switzerland and Indonesia during 1957 re-emphasized the ubiquitous nature of uranium occurrence, whilst the identification of coffinite in Cornish mine dumps raised hopes that the search in progress may yet locate a domestic source of uranium ores.

Low Grade Sources

American experimental work is continuing on a separation process which may economically recover the large quantities of uranium present in the lignites of Montana.

In Britain a process for recovering uranium from phosphate rock as a by-product of phosphoric acid manufacture was patented during the year, whilst scientists in the Soviet Union claimed to have developed a chemical method for the extraction of the uranium present in sea water (½ oz. per million gallons).

Future Markets

Nuclear power station construction programmes received several setbacks during 1957. The U.K. programme for constructing stations of 6,000 MW capacity was watered down as a result of the introduction of new credit restriction policies. The Euratom 15,000 MW programme is apparently as far off as ever. In Western Germany a contract to construct a reactor station was cancelled. A nuclear "incident" occurred at Windscale during the year, whilst a serious defect developed in a reactor supplied to Denmark by the U.S.A., and these events must have discouraged some of the private industrial concerns who have been tentatively investigating the application of nuclear power to their operations.

British concentration on the "Calder Hall" type reactor would appear to have been justified. Italy has ordered a 200 MW reactor of this type from a U.K. nuclear power group, whilst Japan called for tenders for a 150 MW station and West Germany displayed interest in a further 150 MW reactor of British design.

In the United States the nuclear power programme came in for a good deal of criticism during 1957 when the Wolverine project was stopped after capital expenditure estimates rose four times to $14,400,000. America has a large number of research reactors, but in all cases estimates for her first power stations have been greatly exceeded and capital costs are currently estimated at about twice those of the U.K. reactor stations.

The application of nuclear power to ship propulsion shows much promise, though here again the demand is mostly military. However, during 1957 the first atomic powered surface vessel—the ice-breaker "Lenin" of 25,000 tons—was launched at Leningrad and the total number of atom powered vessels built or planned in the U.S.A. increased to 21, mostly submarines. In Britain work has started on the first of the Royal Navy's nuclear submarines, and planning is in progress for an atomic merchant ship to be launched in 1964. Various design studies on reactor-powered submarine tankers were also commenced in 1957.

Lack of information on nuclear aircraft propulsion makes future development impossible to assess. The launching of earth satellites in 1957 has focused attention on nuclear-powered rockets as a means of conquering space, and American research studies are in progress.

The continued emphasis on military uses for uranium is apparent and whilst the uranium requirements for weapons still remains secret, this demand must be more than covered by existing production facilities, and moreover, it would be reasonable to expect that it will diminish.

Outlook

The situation in the United States would seem to provide the key to the future of the uranium industry of the Free World.

The oversupply of uranium in America has been a result of domestic production expansion far in excess of that anticipated when the overseas contracts were made. In the period 1960-1966 many of these contracts expire and no new commitments have been made. Meanwhile a strong uranium industry has been created capable of expanding to meet civil demands as the peaceful uses of atomic power are developed.

The indications are that the development of this demand will be a much slower process than was originally thought. The pressurized water reactor on which the U.S.A. has concentrated is now accepted to be an uneconomic unit and there is an increasing stress on the advantages of a natural uranium-fuelled reactor. Nuclear propulsion for naval vessels will increase America's uranium consumption but as far as land-based reactors are concerned the present programme does not hold great promise of creating a large market for nuclear power stations either in America or for export. A total of 25 U.S.-built research reactors have been exported or contracted for but these units constitute neither a commercial bonanza nor an important market for uranium.

The success of British-built reactors and the export of these units to foreign countries has an important effect on uranium demand. A natural uranium fuelled reactor provides independence of the American diffusion plants which manufacture the enriched uranium fuel for U.S. reactor types and enables the future use of domestic uranium production to be envisaged by many of the nations now contemplating nuclear power. A free market in uranium may be considerably advanced in this way.

With a uranium production capacity in excess of immediate requirements the U.S.A. would also be interested in the overseas market for its uranium whilst other producers, notably Canada, foreseeing the end of the American contracts, are already investigating such outlets. A free and highly competitive market for uranium might safely be predicted in the near future, especially as the U.S. Atomic Energy Commission is also working to this end.

Once the uncomfortable period whilst existing contracts run out is negotiated, how are the major producers likely to fare in a normal competitive market? If a free market for uranium means concentrates at less than the present contract price of $8 per lb. then it is apparent that many present producers cannot survive. The highest grade producer, the United States, is also the highest cost producer per ton of ore, whilst the low grade South African mines, assigning much of production costs to gold mining operations, are also the lowest cost producers per ton. The statement accredited to J. T. Sherman of the A.E.C. that South Africa as the principal low grade producer should go to the wall first is not borne out by mill cost figures quoted during the year.

American milling costs are of the order $2.50 to $3.00 per lb. U_3O_8 leaving a margin of around $5 per lb. of concentrate to cover all mining costs, depreciation, etc. In four of the larger producing areas these costs average between $11 and $20 per ton of ore mined, which would mean ore-limits in the region of 2 to 4 lbs. U_3O_8/ton ore with uranium at $8 per lb. America is fortunate to possess ores of richer grade than this whilst certain opencasted ores are mined at much lower cost. American producers are probably well satisfied with current contract prices of over $10.50 per lb. and could tolerate a price fall without undue hardship.

Canadian milling costs per ton of ore have been reported in the U.S.A. to be $6 to $10 although Bicroft Uranium Mines has released a treatment cost figure of $3.86 per ton well outside this range. Total operating costs at Bicroft are $11.61 per ton of ore and are exhibiting a downward trend. At Pronto Uranium Mines profit on ore of 2.55 lbs./ton U_3O_8 content was $8.93 per ton indicating operating costs of the order of $17 per ton. In South Africa treatment costs are less than £1 per lb. of concentrate produced and total costs in many cases are probably under 30/- per lb. U_3O_8 produced. On the basis of these figures it is Canada amongst the three major producers that would be most anxious to see uranium prices maintained.

During 1957 the U.S.A. imported the bulk of Canadian uranium production with only a very small amount going to the U.K. Total imports were 11,826 tons. America is now faced with a problem of over-supply and there is much agitation by the domestic industry against the importing of foreign concentrates under existing contracts at a price higher than that paid to American producers. The recent conclusion of large contracts between the U.K. and Canada for the supply of concentrates indicates that the U.K., having firm demands for uranium is, to some extent, relieving the U.S.A. of this problem. America has obviously also been taking the greater part of South African production and the present outlook on future U.S. requirements does not foreshadow a successful outcome of discussions now taking place in which the Union is lobbying the expansion of her uranium programme.

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Unhampered by recession, research at the moment is outstripping industrial development and much of the anticipated expansion of power generation capacity which was to have been met by uranium-fuelled reactors could now take place at a time when advantage might be taken of the second stage of reactor development. The thorium-fuelled Dounreay plant is to go critical in 1958 and this type of fast-breeder reactor has been regarded as the ultimate nuclear generating plant. Rio Tinto-Dow Ltd., formed to investigate the recovery of thorium from the waste liquors of the Blind River Mines, may make this field an important contributor to both stages of atomic power development.

So rapid is scientific progress in recent years that some have already seen in thermonuclear fusion reactors a successor to power generation by uranium fission. Encouragement was given to such thoughts during 1957 by the release of information on the achievements made with ZETA at Harwell. However, the engineering difficulties involved in constructing a fusion reactor must be enormous and whatever the course that nuclear research may run, the uranium industry must play an important part in power generation in the future. The role, however, will be a competitive one and all the energy shown in the creating of the industry will be required if it is to advance and thrive.

LITHIUM *By A. G. Thomson*

IN some respects lithium had a disappointing year in 1957, its progress being slower than had been expected, but renewed interest has been aroused by recent developments in rocket and space propulsion fuels. It has been found that lithium compounds may be a potential source of power for types of engines other than those in jet planes and missiles, while the use of lithium alloys in high temperature resistant jet and rocket skins also holds considerable promise. In the atomic energy field, lithium hydride as an "on the spot" source of hydrogen might play a very important part in the production of nuclear power.

Elsewhere the lithium industry is waging an uphill struggle for wider acceptance. Lithium metal is now being used in the synthesis of Vitamin "A," in antihistamine products, as an alloy for non-ferrous metals, and as a scavenger and de-gasifier in the ferrous and non-ferrous fields. One of the most promising developments is said to be its use as a catalyst in the production of synthetic rubber. At present the largest outlets for lithium compounds are in the manufacture of lubricants and in ceramics.

In the absence of comprehensive statistics, informed guesswork places Free World production in 1957 (in terms of lithium carbonate) at about 22,800 s.tons, of which under 20,000 tons was produced in North America, some 375 tons in South America (principally Brazil), and the balance mainly in Africa. These figures suggest only a slight increase over 1956, but compare with 7,500 s.tons in 1955 and between 2,500 and 3,500 in 1954.

The Bikita district in Southern Rhodesia—with deposits ranking among the highest grade in the world—was again the largest producer of lithium minerals (principally lepidolite), output amounting in 1957 to 109,254 tons compared with 90,064 tons in 1956.

Bikita Minerals have announced that the rate of production of lithium ore is to be reduced as a result of delivery of higher grade ore than was originally planned, improved overall efficiency, and the build up of the necessary stockpiles to ensure regular supplies.

The Belgian Congo producer, Geomines, has stopped production of lithium carbonate, its experimental programme having been completed.

An option over extensive lithium deposits at Bikita, owned by Mr. George Nolan has been acquired by Rand Mines Ltd.

Canadian production is currently confined to the Quebec Lithium Corporation's mine in north-western Quebec, but the Dominion has several known large deposits of a relatively good grade. Quebec Lithium plans to construct a lithium refinery and chemical plant facilities at Rouses Point on the Canadian-U.S. border. The new plant, which is expected to cost about $3,000,000 initially, is scheduled for production early in 1959.

U.S. producers are believed to have a combined chemical capacity of over 20,000 tons annually of lithium carbonate equivalent, but none of the plants are operating to capacity.

It is believed that the U.S. Government purchases nearly three-quarters of the total lithium output of North America. An estimated 12,500 s.tons is used by the Atomic Energy Commission, who are reported to be extracting small quantities of the isotope Li-6 and returning or stockpiling the tails for eventual return to the civilian markets. These tails are suitable for many industrial uses.

In view of the slow-down in the expansion of lithium consumption, the three major U.S. producers formed the American Lithium Institute to promote new uses. It was decided, however, that the functions of the Institute should be taken over by the Manufacturing Chemists' Association.

In December, 1957, substantial price reductions were announced by American Potash and Chemicals Corp., lithium carbonate in carload lots being reduced from 75c. to 67c. per lb. Earlier in the year it had been quoted at around $1.30 per lb.

Outside the nuclear and rocket fuel fields, the future of the lithium market appears to depend on the availability of lithium chemicals at lower prices. It has been stated that the scope for expansion is unlimited and when prices drop, new applications will be inaugurated which will more than triple consumption. Of interest in this connection is the claim that a process capable of producing lithium metal at a cost 50 times less than the process now used in the U.S. has been developed by German scientists.

With large ore reserves and excess chemical capacity, the lithium industry is well placed to meet increasing demand. The possibility exists, that the export of Rhodesian lithium to the U.S. might be affected by recent American progress in the economical operation of large low-grade deposits, but, if so, this would doubtless be offset by rising consumption in the U.K. and elsewhere.

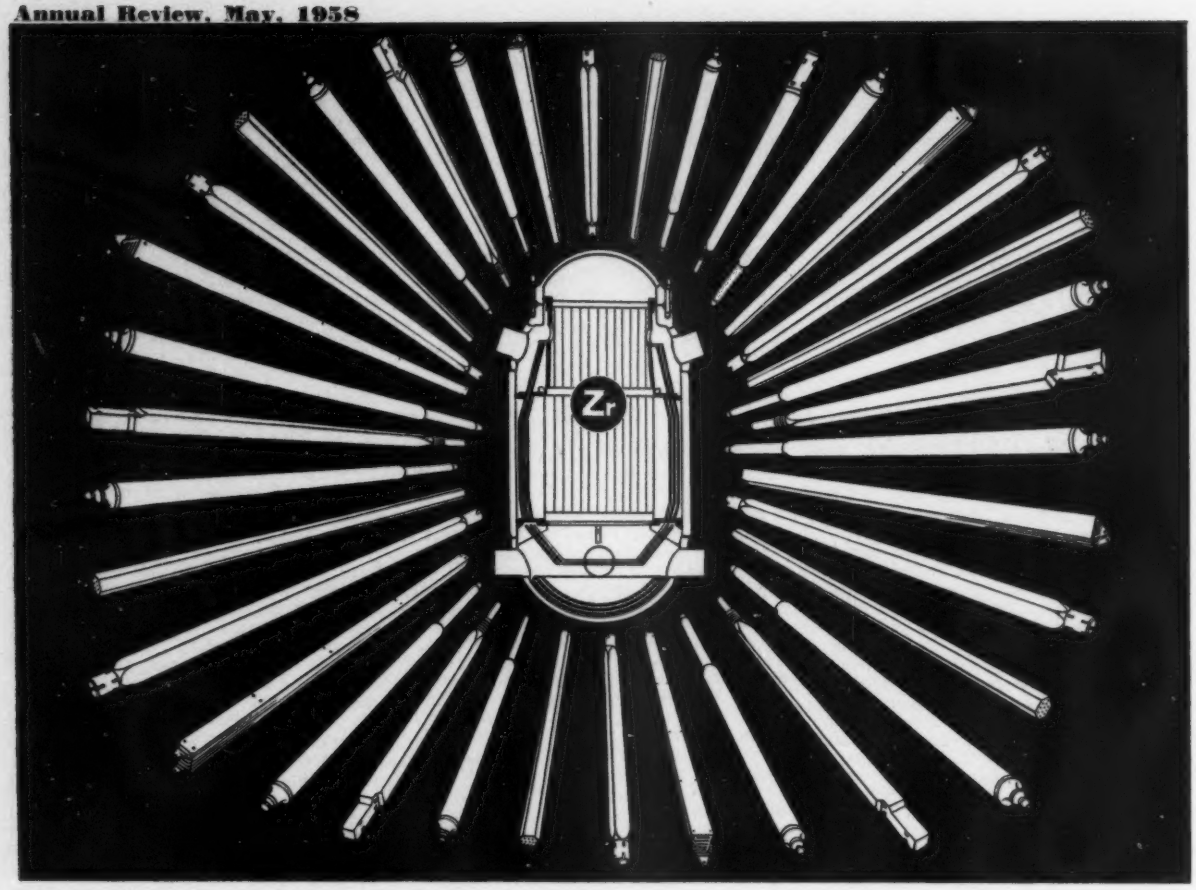
THORIUM, THE LANTHANONS, YTTRIUM

MONAZITE has for many years been the main commercial source of thorium, the lanthanons and yttrium. Since 1951, the bastnasite deposits at Mountain Pass, California, have also provided considerable amounts of the lanthanons and yttrium. It now seems probable that a new source of these materials will become available. The uranium-bearing minerals in the Blind River area of Canada also contain thorium and the lanthanons. These remain in the barren liquor discharged after uranium extraction. One of the largest mining organizations operating in the area, Rio Tinto Ltd., announced that it was joining with Dow Chemical Co. to form a new company to extract thorium and lanthanons from the barren liquors. There is little reliable information on the present production of monazite and bastnasite but it is probable that material potentially available from the Blind River area is much greater than that produced from either of the two ores.

This new development was announced late in the year and had no effect on the monazite prices ruling during 1957. These appeared to be steady at about £130 per ton of monazite containing 60 to 65 per cent of thorium and lanthanon oxides. When sales of monazite are reported it is not usually stated what the ratio of lanthanons to thorium is. This can vary from about 15.1 down to 6.1.

Much information on the recovery of thorium from monazite and on the chemistry of thorium has been published, particularly by the American Atomic Energy Commission. Complete details of sulphuric acid and caustic soda processes for opening the ore have been given. Much work has also been reported on solvent extraction processes for purifying thorium. The preferred solvent for these processes is tributyl phosphate diluted with an inert hydrocarbon. There has also been mention of similar processes for separating and purifying the lanthanons but most effort in this field has continued to be devoted to ion-exchange methods.

There has been some discussion of the use of thorium in atomic power production but it has also been said that thorium does not represent any threat to uranium which is now available in very great quantities. It is possible that the interest of atomic energy authorities in thorium is declining. It was announced during the year that W. R. Grace & Co. were negotiating with the American A.E.C. to terminate a contract for the supply of thorium oxide which was "no longer in the same demand status."



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No new uses for thorium have been reported and the major demands have continued to be for making incandescent mantles, in metallurgical uses, in refractory making and in optical glass manufacture.

Separation of the individual lanthanons progressed considerably and relatively large quantities of every member of the family are now commercially available in America. Prices of most of these are still high. The bulk of the lanthanon material used commercially is still the undifferentiated mixture obtained from monazite or bastnasite.

The mixture is used in many metallurgical applications, in arc carbon manufacture, in glass making, in glass-polishing material in paint driers and in some catalytic uses. New uses are frequently suggested, either for the mixture or for the individual elements, but none of these yet shows signs of leading to greatly increased demands.

There are some indications that improved processing methods and increased production are leading to price reductions both of thorium and the lanthanons. This fact, combined with the increased interest shown in these materials in recent years, will probably lead to a considerably greater number of minor applications in many fields of technology. There does not seem to be any prospect that usage for any particular application will increase greatly in the near future.

ZIRCONIUM AND HAFNIUM

ZIRCONIUM and hafnium owe their existence as commercial metals to the requirements of atomic energy programmes. Among zirconium's desirable characteristics are high resistance to corrosion, a melting point of 3,350 deg. F. and a low neutron cross-section. Zirconium also has excellent gettering properties which have led to a growing demand from the electronics industry for use in the manufacture of vacuum tubes.

"Commercial grade" zirconium contains hafnium which, because of its high neutron cross-section, has to be removed in the production of reactor grade metal. Hafnium also has important atomic uses.

Zirconium is produced in the U.K. by Murex Ltd. at Rainham, Essex, and zirconium tetrachloride and other compounds by Elektron Ltd. at Clifton Junction, Manchester. The separation of hafnium is also undertaken in the U.K.

Production in the U.S. is being expanded so rapidly that it was expected to increase ten-fold during 1957. Some 30 processors and manufacturers of zirconium and hafnium products are listed in a recent survey by the U.S. Bureau of Mines.

Zirconium metal is following the traditional price curve of metals under development, the price declining as production improves. The Carborundum Corporation, a leading U.S. producer, is now selling reactor grade zirconium sponge at $7.50 per lb. against $15 in 1956. This reduction was made possible by a new plant in Parkersburg, West Virginia, brought on stream in September, 1957, which will produce about 600 s.tons annually of zirconium sponge. National Distillers and Chemical Corporation, another important producer of the metal, has also been charging about $7.50 a lb. Both companies are supplying the Atomic Energy Commission with zirconium sponge under Government contract, National Distillers' present price under these contracts being $4.54 a lb., while that of Carborundum is believed to be slightly above $8.

Reactive Metals, Inc., a company recently formed by Mallory-Sharon Titanium Corporation and U.S. Industrial Chemicals Co., Division of National Distillers and Chemical Corporation, produces ingots and a complete line of mill products from zirconium, hafnium and other reactive metals at Ashtobula, Ohio, where a new plant was constructed last year. The originally planned capacity of 750 s.tons annually was revised to 1,000 tons because of growing needs.

The Wah Chang Corporation operates for the U.S. Government a zirconium plant in Oregon of about 150 s.tons a year capacity. This company has also built a new zirconium plant of its own at Albany, Oregon, with a capacity believed to be about 100 s.tons a year.

Another company, Firth Sterling, Inc., was recently awarded a $1,500,000 contract by Westinghouse Electric Corporation for the melting of zirconium ingots from sponge and conversion into finished mill products. This was the first integrated contract given in the U.S. to a single company to carry out the melting as well as the rolling of zir-

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Japan's output of zirconium is to be expanded to an annual level of 510 tons by the end of March, 1959. The Tokyo Zirconium Co., at present Japan's sole producer, announced the start-up of a plant capable of producing 10 tons monthly. The company had a contract with the U.S. A.E.C. for the delivery of 200 s.tons of zirconium by the end of 1957.

So far, the commercial market for zirconium metal has been on a minor scale, but good prospects for commercial development are indicated, particularly for applications in chemical processes where outstanding resistance to highly corrosive reactants is required. Designers of piping in the chemical and nuclear fields are specifying zirconium metal and alloys in increasing quantities.

BERYLLIUM

BERYLLIUM continues to make headway both industrially and in the nuclear field, while potential outlets are also foreseen for this metal in aircraft and guided missiles. Because of its low thermal neutron absorption cross-section, beryllium can be employed in the manufacture of many different types of reactor hardware. Industrially, the most important use of beryllium is as an alloying agent to harden and strengthen other materials, chiefly copper.

In the third group of nuclear power stations to be built in the U.K., it is desired to increase the temperature of the fuel elements from 400 to 600 deg. C., thereby reducing the capital cost of the power output. One requirement is to change the fuel elements from a magnesium alloy to beryllium metal or a beryllium alloy. Beryllium's melting point is nearly twice that of magnesium, which is 650 deg. C. Using beryllium in the reactor core has the primary advantage of conserving neutrons and giving uniform flux densities. These factors make the reactor core smaller.

The U.S. Air Force is interested in beryllium for high-speed fighting planes as being virtually the only metal that will perform at high strength above 1,000 deg. F. Moreover, a plane made mostly of beryllium would weigh about half as much as to-day's basically aluminium plane. It is believed that a contract awarded to Brush Beryllium by the Air Material Command of Dayton for the development of sheet-rolling may result in a satisfactory air-frame material which would withstand temperatures up to 1,500 deg. F. The cost of a finished beryllium structure, however, is expected to be $75-$100, against $20-$40 per lb. for aluminium. Beryllium is also one of the most promising metals for missile nose cones and a possible answer to the problem of re-entry into the earth's atmosphere.

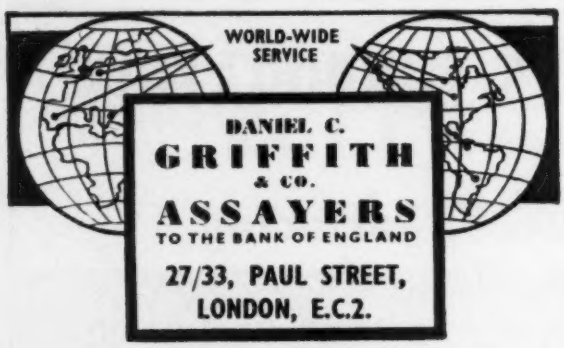
The two major producers of beryllium metal, both American, are the Beryllium Corporation, of Pennsylvania, and the Brush Beryllium Co., of Ohio, both of which have contracts valued at $23,000,000 from the A.E.C. The former company's new beryllium plant at Ashmore, Pa, was officially opened in August, 1957. Over the next five years it will produce 250 s.tons of high-grade beryllium metal, all of which will be sold to A.E.C. Brush Beryllium is currently producing atomic reactor grade beryllium metal for the A.E.C. at Luckey, Ohio.

The chief product of the U.S. beryllium industry has been beryllium-copper alloys. However, an increase in beryl imports from about 6,500 tons in 1955 to over 12,000 tons in 1956 indicated a substantial amount of stockpiling, largely for commercial production of beryllium in quantity during 1957-58. A programme for domestic purchases of beryl is under way.

In the U.K. the development and production of beryllium metal are being undertaken by Murex Ltd. A pilot plant for the production of beryllium metal is being operated on behalf of the Atomic Energy Authority by the Consolidated Zinc Corporation Ltd. Small beryllium plants are being operated commercially in France and the U.S.S.R.

Unfortunately beryllium is costly to mine and has to be refined under vacuum to keep out impurities that render it brittle, and it is even more difficult to shape than titanium. Moreover, beryl, the principal beryllium mineral, though containing only about 4-5 per cent Be., costs some $500 per ton and is by no means plentiful.

World production of beryl is estimated to have fallen in 1957 to 7,500 s.tons from 12,500 s.tons in 1956. In the latter year the largest producers were India 3,360 l.tons, Brazil 2,000, Belgian Congo 1,800, Argentina 1,722, Mozambique 950, S. Rhodesia 606, the U.S. 460, and South-West Africa 454. Southern Rhodesia produced 572 tons in 1957.



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The Fuel Minerals

COAL • OIL • NATURAL GAS

COAL *By A. Grierson, B.Sc., M.I.M.E.*

THE year 1957 was marked by the tremendous strides taken in the field of atomic energy. Far from being in the distant future it now appears likely that the impact upon industry of the non-fossil fuels is going to be felt much quicker than was envisaged a few years ago. Revised estimates of the contribution nuclear energy is likely to make have been issued with bewildering frequency and, despite official assurances, there appears to be some apprehension regarding the long term prospects for coal—and the coal mining communities. That some of the existing high production cost mines in industrial countries will be priced out of operation appears inevitable, although it should be equally apparent that the advent of nuclear power will in no way detract from the fundamental importance of coal to the economy of individual nations.

The table below shows the coal output of the main producing countries for the last three years. In most countries the slight decline in output can be attributed chiefly to an increased use of oil and a fall in domestic consumption.

United States

Both bituminous and anthracite figures were down. In the soft coal industry production fell from the 1956 total of 501,000,000 s.tons to 488,000,000; representing a drop of about 2.6 per cent. Anthracite output was down by 3,000,000 tons to 25,200,000. The drop is attributed generally to a slight lowering in industrial activity and to further captures by the oil and gas producers. The competition of non-solid fuels in the electric utilities—a key market for coal—is yearly becoming more intense. In 1957 total gas consumed in power stations, etc., was up by 10 per cent on the previous year and oil consumption up by nearly 11½ per cent. During this period the coal market only benefited by an ominously meagre 3 per cent gain.

Fortunately for the U.S. colliery operators, the export market remained wide open and despite a slight fall in the tonnage of anthracite exported the total amount of coal sold to other countries reached a record 85,000,000 tons. Although many authorities are predicting even bigger export sales in the current year, the inordinately high stocks of coal currently held in Western Europe suggest that such forecasts are over-optimistic.

The coal operators are not taking the oil and gas threat lightly. During the year, for example, producers, railways and other allied interests, organized to develop a 12,000,000 ton utility market in Florida now based primarily on oil. The legislative battle against the encroachment of natural gas suppliers continued during the year with little material success. Mandatory control of residual imports also seems to be an out-of-reach desideratum.

Taken overall, however, the U.S. coal industry had a reasonably good year and can expect to maintain a high level of production in 1958.

Canada

Although Canada has recoverable soft coal reserves of 50,000 million tons, the market for coal is so depressed that investment within the industry has for many years been at a comparatively low level. In the past seven years the total consumption of coal, both indigenous and imported, has fallen by roughly 33 per cent from the 1950 figure of 45,000,000 tons. Unfortunately for Canadian operators their main markets are the industrially developed areas of Quebec and Ontario; since these centres are geographically nearer the U.S. coalfields of Pennsylvania and Ohio it is cheaper to import coal from the States.

In 1957, rather more than 20,000,000 tons of U.S. coal were imported. For many years the Canadian industry's transport costs have been subsidized to enable indigenous coal to compete with imported coal, and also substantial loans have been made to the industry. With the help of these loans a number of improvements have been made in Nova Scotia and New Brunswick, which include the installation of extensive belt conveying systems and the development of underground face machinery. Large drag lines for strip mining operations have also been purchased.

The coal industry, especially on the Atlantic seaboard, is passing through a transitional stage. Capital expenditure incurred on mechanization has not yet produced commensurate financial returns: substantial trading losses, short time working and temporary closing of mines have been common.

In the immediate future it appears inevitable that the market for coal in Canada will be invaded to an increasing extent by oil, natural gas and hydro-electricity. Despite the anticipated growth of population and industry in Canada there is little prospect of any early revival of the coal mining industry.

Western Europe

During the year a slackening in the rate of economic expansion took place in the European Coal and Steel Community countries—particularly marked in the Benelux group. For the first time since the inception of E.C.S.C. in 1952 annual coal production in the Pool countries fell below the total for the preceding year. At 247,850,000 tonnes coal production was 0.5 per cent below the 1956 figure, although last year's output was still 3.8 per cent above that obtained in the first year of the Community's operations.

As will be seen in the table, coal output declined in all the member countries with the exception of France which recorded an increase of just over 0.3 per cent.

The French underground O.M.S. of 1.7 tonnes retained for them the title of Community Productivity Champions. During the year France took many Italian workers into the mines and this was largely responsible for an increase of 3,000 face workers. In spite of this record domestic output the country had to import 20,000,000

COAL PRODUCTION IN THE COMMUNITY
(Excluding lignite)
(In thousands of tonnes)

	1955	1956	1957
Belgium	29,960	29,546	**29,076**
France	55,322	55,121	**56,786**
Saar	17,298	17,078	**16,451**
Germany	130,728	134,378	**133,145**
Italy	1,119	1,049	**1,026**
Netherlands	11,843	11,821	**11,370**

MAIN PRODUCING COUNTRIES
(In millions of tonnes:)

	1955	1956	1957
U.S.A.	446	489	**466**
U.S.S.R.	390	430	**483**
European Community	340	347	**248**
U.K.	226	226	**228**
Poland	94	95	**94**
India	38	39	**42.6***
Union of South Africa	33	34	**36**
Australia	30	30	**32**
Canada	14.5	15	**13.4**

*Estimated. Figures include lignite and and anthracite

tonnes of coal, most of which came from member countries although large supplies were imported from the U.S. and Poland. Indeed Polish coal sold very cheaply in Europe last year and some authorities considered the selling price to be below cost of production. Poland is making strenuous efforts to regain her pre-war position as a major exporter.

Approximately 37,000,000 tonnes of U.S. coal were landed in the Community last year and with freight charges plummeting downwards to below 30s. per ton, cost of American coal was sometimes less than that of Pool produced. Massive imports of U.S. coal, together with a slight recession in Belgium, led to the community building up embarrassingly large pithead stocks in 1957. Indeed, demand for local coal decreased to such an extent that short time working was unavoidable at some collieries. With the falling off in demand for coal the high Authority inaugurated a three-monthly inquiry into the individual Governmental contracts for American coal, many of which were negotiated with U.S. producers on a long term basis at a time of acute fuel shortage. The information collected from these inquiries will enable remedial measures to be quickly taken should the situation show signs of getting out of hand.

Great Britain

Total output during the year, including opencast, was 223,600,000 tons; a rise of 1,600,000 tons. This rise, however, was due almost entirely to an increase in opencast production from 12,080,000 tons in 1956 to 13,580,000 tons. Indeed, opencast operations in Britain are now an essential part of the industry and over the past few years have been responsible for the slight increases in the overall figures which have been registered.

Output per manshift (overall) at 24.62 cwt. was practically unchanged, although an increase in the rate of absenteeism was reflected by a drop in the output per man year—295 tons compared to 298 tons in the previous year. During 1957 the number of wage-earners rose by 7,500 and towards the end of the period recruitment was deliberately slowed down in some parts of the country.

The year ended with record high stocks. Coal consumption in Britain had risen at an annual rate of 3,000,000 tons over the last 10 years and at the beginning of 1957 it seemed reasonable to assume that the rising trend would continue. In fact, inland consumption dropped by more than 5,000,000 tons and stocks distributed plus those at collieries amounted to 27,500,000 tons at the end of the year. The greater part of these stocks consisted of small coal.

The tendency to produce more small coal has been manifest for some years—attributable mainly to the rapidly increasing tonnage mined by power loading machines. In 1957, 54,000,000 tons of coal were power loaded—more than twice the tonnage power loaded two years before. Concerned about the increase in make of small coal (93,000,000 tons) the Board during the year launched a drive to cut down the degradation of coal in mining operations. Much development effort was devoted to modifications of existing machines and production of new types giving less fragmentation.

Britain last year exported 7,750,000 l.tons and imported 2,750,000 tons. The export figure could not be increased, since Continental stocks of small coal were also unusually high and the bulk of Britain's surplus unfortunately is of this type.

Total capital expenditure during the year was £100,000,000 of which expenditure at the collieries was £80,600,000. By the end of 1957 the Board had approved since Vesting Day 230 major colliery schemes each costing more than £250,000.

Eastern Europe

During the year the U.S.S.R. continued to develop and expand the coal industry and an extensive boring programme was continued. Reserves proved to date are quoted as 650,000 million tons of hard coal and 120,000 million tons of brown coal—the bulk of these reserves lying above 1,200 ft. depth. In the interests of rapid expansion in output many drift mines have been developed. These are usually small units working seams down to 600 ft.

Two of the Russian satellite countries are also developing their coal industry at a rapid pace. In Poland, output has risen from the 1951 figure of 87,000,000 tonnes to a record 94,096,000 tonnes in 1957. In Czechoslovakia production last year was rather more than 80,000,000 tons (including lignite and anthracite) representing a 6.2 per cent rise on the 1956 output and an increase of 60 per cent since 1951. Both countries stepped up the export of coal to other European countries; Poland alone exported more than 9,000,000 tonnes to Western countries during the year.

South Africa

Although South Africa is primarily a producer of gold and diamonds, the Union has a thriving coal industry which last year produced almost 36,000,000 tonnes. This output represented an increase in production over the last decade of 40 per cent. About 60 collieries are currently producing and coal reserves are estimated at some 200,000 million tons. Production costs are amongst the lowest in the world and the average pithead price of coal in South Africa was 11s. 5d. per ton. At Sigma Colliery in the Witbank field the pit head price was as little as 6s. 0d. per ton due to extremely high productivity: 350 non-Europeans and 40 Europeans being responsible for 7,600 tons daily.

Since the war inadequate surface haulage facilities have retarded the industry's progress but this situation is now being remedied and if further oil-from-coal plants come into operation the coal industry could assume greater significance in South Africa's economy.

OIL AND NATURAL GAS *By W. J. Harris*

WHEN the writer undertook the task, a year ago, of reviewing the major developments then characterizing the international oil industry's affairs, a grave situation had to be reported. The Suez Canal was blocked and the pipelines running from the Iraq oilfields to the Mediterranean had been cut through damage to the pumping stations. The whole of the Free World was experiencing considerable and understandable anxiety as to whether its vital petroleum supplies could be maintained at a level which would avert any major disruption of its industrial and economic structures. The oil industry was at grips with as complex and as difficult a situation as it had ever encountered in times of peace.

Happily, this situation has become one of historical rather than practical significance. In a far swifter time than at first was thought feasible, the Suez Canal was cleared and the oil tankers resumed their use of this waterway. Energetic repair work on the pumping stations of the Iraq pipelines led to these facilities being put into partial operation again at an early date, although they may not be restored to maximum capacity until the late spring or early summer of 1958. Even before the last of the blockships had been raised from the Canal or oil had again begun flowing through the Iraq pipelines, the efforts of the oil companies to surmount the crisis had begun to make the industry master of the position. By early April, when the Suez was reopened to shipping, the general world oil supply situation was fast returning to normal.

Consequences of the Suez Crisis

If there is a lesson to be drawn from the outcome of the Suez dispute so far as the petroleum industry is concerned, it may be that this crisis underlined in unmistakable fashion the importance of the industry's essentially international nature. This factor, allied with the extremely high degree of integration and flexibility characterizing the many large oil companies, enabled emergency planning to be formulated and the necessary executive measures to be implemented in a manner that would otherwise have been impossible.

Working as a single team, calling upon all available production, transportation and refining resources regardless of ownership and location, the oil companies succeeded in keeping a firm grip on the general supply position even though miracles of day-to-day extemporization had to be achieved in the process. The result was that the impact of the Suez problem upon oil supplies was far less than had generally been expected.

Nevertheless, the very success of the measures taken to offset the potential dangers of the Suez impasse led to certain complications once this dispute had been terminated. In order to ensure adequate crude oil supplies for as long as those normally drawn from the Middle East might be curtailed, production in other parts of the world—in particular in the U.S.A. and in Venezuela—was increased at as rapid a rate as possible. Since one obvious feature of any prolonged blockage of the Canal would have been a sharp growth in the industry's oil-tanker requirements—so as to cope with the longer hauls entailed in alternative transportation routes—shipbuilders were urged to accelerate deliveries of tankers nearing completion. The ending of the emergency period, therefore, found the industry with both very substantial stocks and considerable additional tanker tonnage at its disposal.

This situation might very well, in the ordinary course of expanding international industrial activity, and hence increasing oil consumption, have been adjusted by the

simple laws of supply and demand before 1957 reached its close. However, although world commerce—and world oil consumption—did indeed register a net growth rather than a decline last year, the rate of growth slackened instead of accelerating as in earlier twelve months. This has retarded the dispersal of accumulated stocks. It may fairly be added that the present state of affairs is due in no small degree to a relatively mild winter and to the recent lull in business activity in the U.S.A., where the demand for petroleum products has been almost stationary during 1957 as a whole.

Elsewhere, the rising trend of oil consumption has been affected by various factors: in Britain, for instance, larger coal supplies have brought a slowing down in the rate of conversion of power-generating plant and factory furnaces to oil fuel, though it has also been said that the inherent advantages of oil as opposed to solid fuel for many industrial purposes are likely to inspire the continued adoption of the former product regardless of the availability of the alternative choice.

Necessity for Long-Term Planning

Notwithstanding the temporary lethargy in world commercial expansion, and its influence upon demand for petroleum products, the oil industry cannot afford to formulate its plans on any short-term basis. New refineries and other similar facilities take years to build, while the development of commercial production in a newly discovered oilfield may take even longer. Thus, much of the work of the industry during 1957 has been undertaken with a view to ensuring adequate supplies during 1958, 1959 and the early 1960's.

At the beginning of 1957, over 100,000,000 tonnes of new refining capacity was planned for countries outside North America and the U.S.S.R. bloc; approximately one-third of this capacity has already been completed. Closely associated with refineries are new petroleum-chemical plants being erected in Britain and a number of other countries, while less spectacular—though no less important—additions are being made to storage and internal distribution facilities. In the U.K., for example, there has been marked progress in the better organization of petrol distribution through the opening of new depots.

The construction of additional oil tankers and pipelines also came in for active consideration during the year under review. At the close of 1957, tanker tonnage on order or in course of building in all countries totalled no less than 40,000,000 deadweight tons. This was not much below the entire tonnage of the world's tanker fleet then in actual service—which approximated to about 50,000,000 d.w.t. This spate of construction may seem incompatible with the undoubted fact that an appreciable quantity of tanker tonnage is now being laid up as redundant, but the apparent contradiction in logic is, of course, largely explained by the fact that as great a delay as five years may elapse between placing an order for a new vessel and receiving delivery of the ship in question. Over 70 per cent of the oil supplies consumed each year by the Free World exclusive of the U.S.A.—and 35 per cent of those supplies needed by America herself—involve sea transportation at some or other stage, so the oil industry cannot take any risk of a bottleneck developing in its distribution system through lack of tankers. Moreover, it has been estimated that by 1975, world oil consumption will exceed 1,500,000,000 tonnes annually (roughly double its requirements of 1955).

WORLD OIL PRODUCTION

(*Inc. Natural Gasoline*)

(Thousand Metric Tons)

	1956	1957*
U.S.A.	383,100	383,800
Venezuela	129,100	145,400
U.S.S.R. (inc. Sakhalin)†	83,800	98,000
Kuwait	55,000	57,300
Saudi Arabia	48,700	48,900
Iraq	31,300	21,900
Persia	26,500	35,500
Canada	23,700	24,900
Mexico	13,200	12,600
Indonesia	12,700	15,400
Others	61,800	69,800
	868,900	913,500

* The figures for 1957 are preliminary and provisional.

† Estimated.

If this expectation is fulfilled, it seems as if a world tanker fleet of nearly double the existing size will be the minimum required to meet foreseeable future commitments.

Pipeline Profits

In the realm of pipelines, among the several major projects implemented or discussed during 1957 two are of especial interest to Western Europe. The first concerned a proposal to build a crude oil line from the Persian Gulf area to some convenient terminal on the Mediterranean—probably with this terminal being sited on the Turkish seaboard. At the time of writing, this proposal seems to have been replaced, at any rate for the moment, by a scheme to build a 1,000-mile pipeline from the Qum oilfield in central Persia (a field not lying within the operational zone of the Persian oil consortium group of companies) to a terminal at the Turkish port of Iskenderun. The project has reached a stage where a company has been formed to undertake the venture, the cost of which has been provisionally estimated at between $450,000,000 and $500,000,000, but final decision on the matter will be governed, among other factors still under discussion, by a more detailed assessment of the potential of the oil resources in Qum and adjacent areas.

The second proposition envisaged a Trans-European pipeline system linking the Mediterranean coast of France with ports and refining centres in northern Europe. It is likely that both these projects will receive renewed attention in the year ahead.

In the U.S.A., where are located some four-fifths of the 300,000 or more miles of main oil and natural gas pipelines in operation throughout the world (exclusive of the U.S.S.R. bloc), additions are so frequent as to become commonplace and development of these networks continued through 1957.

Exploration

Exploration and production are, of course, the fundamental activities of the petroleum industry. This work must—and does—go forward as persistently and as uninterruptedly as the tides of the oceans rise and fall, nor would it be realistic to expect that every year will see at least one dramatic discovery of some outstanding new oil deposit achieved. Last year, though without any sensational successes, brought worthwhile, if unspectacular rewards.

In Venezuela, where output constituted yet another annual record, the granting of numerous fresh concessions in the Lake Maracaibo area led to more than one valuable find being reported. In this area alone, where British interests are among those prominently represented, operators are spending at the rate of over £50,000,000 annually on expansion projects and numerous schemes are being planned as part of the overall development of Venezuela's oil resources.

In North America, both Canada and the U.S.A. saw steady progress maintained in the expansion of existing fields and in the location of new deposits. Particularly interesting has been the increased activity in the "Four Corners" area of the U.S.A.—an area consisting of the four adjacent corners of the adjoining States of Arizona, New Mexico, Colorado and Utah—where a number of highly promising oil and natural gas fields have lately been established.

Offshore operations in the Gulf of Mexico—although still formidably costly in their initial capital requirements and representing a total expenditure of over $2,000,000,000 to date—have been maintained at an active tempo and with constantly improving (if more expensive) equipment. Towards the end of last year, Gulf companies saw the launching of the biggest mobile drilling barge so far impressed into their service—a monster $7,000,000 installation designed to operate in depths of up to 150 ft. of water and which has already been used in sinking boreholes at depths in excess of 130 ft.

Canada, too, witnessed marked progress by the oil companies in defying the barriers of nature—in this case through the design of specialist vehicles which should prove navigable across the treacherous muskeg bogs of the northern territories, hitherto only accessible during winter when these bogs are frozen solid. If, as is hoped, the new vehicles and techniques permit oil exploration to go forward throughout the year, instead of being unavoidably halted every summer, the development of many Canadian oil reserves may be very considerably accelerated.

The Sahara

In other parts of the world, attention has been especially attracted to the advances being made in the Sahara, where oil is already being recovered from the wells at Hassi Messaoud. During the coming year, work should start on a 300-mile pipeline, 24 in. in diameter, scheduled for completion in 1959 and allocated an initial capacity of about 5,000,000 tons per annum. This might be doubled, or even trebled, if the output of the field warranted such a modification. There is, of course, a second important Sahara field lying at Edjele, almost on the Libyan border and some distance south of Hassi Messaoud, and the proximity of this field to the adjoining territory of Libya has given fresh impetus to the search for petroleum now in progress in the latter country.

The Middle East

Among the achievements in the Middle East—where, as will be seen from the production table, outputs of individual countries (with the exception of Iraq owing to the cutting of her pipeline system) bore full comparison with those of 1956 despite the impact of the Suez dispute—

perhaps the most interesting event was the bringing into operation of the first Middle East underwater field, at Safaniya, off the coast of Saudi Arabia. As extensive search is being made for similar offshore resources elsewhere in the Persian Gulf—a venture in which British interests are participating—it may not be long before the Safaniya success is duplicated. Indeed, in December last year an announcement was made of a further discovery not far from Safaniya.

Natural Gas

Before leaving the subject of production, it might be appropriate to add a note on natural gas and its importance as a source of energy. This is perhaps most conspicuously illustrated in the U.S.A., where natural gas is now furnishing approximately 25 per cent of that country's entire energy requirements (as opposed to some 45 per cent currently being derived from crude oil itself). According to an estimate published by an authoritative U.S. source in mid-1957, American consumption of natural gas will increase at a more or less constant rate of just under 5 per cent per annum until 1966, when it should reach an annual total of 16 billion (i.e. million million) cu. ft. This would be over 50 per cent greater than in 1956. After that date, the rate of growth anticipated is a little less clearly discerned, but it is expected that the foreseeable peak demand for natural gas in the U.S.A. will not occur until 1980-1990, when a yearly consumption of some 20 billion cu. ft. is thought to be probable. The well-head value of U.S. natural gas production in 1956—the latest year for which this figure is available—has been assessed at $1,000,000,000, which gives some indication of the value of this particular product in a country where it is readily marketable.

Another country that has benefited considerably through recent discoveries of natural gas deposits is Pakistan. It was in late 1955 that the first consignments of gas were pumped from the Sui field to Karachi via a 347-mile pipeline. At the close of last year, approximately 20,000,000 cu. ft. of gas (equivalent in heating value to some 450 tons of oil) were being supplied every working day to nearly 300 major consumers in the capital. This consumption is said to have represented the replacement of approximately 90 per cent of the total industrial fuel load, plus an appreciable further percentage of commercial and domestic consumption of other fuels hitherto used. The result has been an immensely valuable saving to Pakistan in reduction of expenditure on imported furnace oil and an accompanying stimulus to the development of local industries in the Karachi area.

One could continue to cite other countries in widely different parts of the world where natural gas is proving a useful source of energy. Canada is one obvious example, as are France and Italy in Europe. The two most important deposits of gas so far located in France are at Lacq and St. Marcet, in the south-west region of that country. Extensive work is now in hand to develop both these fields to their maximum potential and to extend the pipeline systems linking them with consumer areas. Italy's gas resources are situated in fields in the Po Valley and these deposits, too, are being utilized on a scale which is becoming progressively greater.

Despite an intensive search for similar deposits in Britain, no discovery of any material commercial significance has so far resulted, but considerable interest was understandably aroused toward the close of 1957 in proposals to test the feasibility of importing liquefied methane (a constituent of natural gas) into this country to supplement our domestic coal gas production. An experimental cargo of about 2,000 tons—drawn from fields on the U.S. Gulf coast—should be delivered to a special terminal, at Canvey Island, Essex, within the next year and if this experiment proves successful, it may lead to bulk importation.

The Outlook

Looking at the prospects facing the oil industry as it surveys its future, there is nothing to be seen that in any way indicates a diminution in long-term commitments or responsibilities. Despite the advent of atomic power and scientific achievements in the thermonuclear field, there remains the opinion in the minds of all qualified to judge such complex issues that the world's demand for energy, emanating from all sources, will grow at a rate which will leave no single source free from strain.

It is inevitable in the evolution of international commerce that periodic lulls in industrial expansion will occur—and it is only logical that such temporary phases should find expression, among other symptoms, in a more moderate demand for oil products. Yet the trend of this demand must remain inexorably upward—that is the industry's own firm conviction and an opinion on which it is basing all its far-reaching plans for the future. It is the thought that will help shape its programmes and its policies throughout 1958.

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PHOSPHATES

FURTHER progress was recorded in 1957 in development of the world's phosphate resources, which were surveyed in *The Mining Journal Annual Review*, 1957, pp. 65-69.

The U.S. is the world's largest producer of phosphate rock. In the year ended June 30, 1957, U.S. output totalled 47,324,000 l.tons, being 1 per cent higher than in the previous 12 months, but marketable production at 14,127,000 l.tons was 2 per cent lower. According to the Bureau of Mines, U.S. Department of the Interior, domestic reserves are adequate for 500 years at the present rate of output. The largest U.S. deposit, so far undeveloped, is situated at Vernal, Utah. San Francisco Chemical Co., jointly owned by Stauffer Chemical Co. and Mountain Copper Co. Ltd., hold exclusive rights to this deposit, which covers some 15,000 acres and has indicated reserves of 700,000,000 tons averaging 21 per cent P_2O_5. This deposit may become a major source of phosphorus within the next few years.

In Brazil the Department of Mineral Production (DNPM) is investigating the possibility of utilizing the bauxite of the Marcacuma River in Maranham as fertilizer owing to its high phosphoric content. Reserves are estimated at 10,000,000 tons, containing 30-40 per cent aluminium oxide, which is being separated for industrial purposes, and 20-30 per cent phosphates.

Phosphate production on Christmas Island is expected to be more than doubled by 1961—from 350,000 to 800,000 tons annually. The Australian Bureau of Mines is currently planning an intensive three-year search for phosphate deposits throughout Australia and its territories, and New Zealand will conduct a similar search, sharing in the cost.

During the six months April-October, 1957, phosphate production in Israel amounted to 75,000 tons, being an increase of 31.5 per cent over the 57,000 tons produced during the corresponding period of 1956. By the end of 1957 production was averaging 17,000 tons per month. There are prospects that Italian firms may participate in a survey of phosphates in the Negev area.

The Jugometal Export-Import Co. of Belgrade, Yugoslavia, signed a long-term agreement with the Jordan Phosphate Mines S.A. for the purpose of increasing and expanding the production of crude phosphates, which is at present at the rate of about 300,000 tons a year.

Phosphate rock production in Morocco rose to 5,567,519 tonnes in 1957 from 5,521,817 tonnes in 1956, while total exports amounted to 5,356,574 tonnes, both figures being records.

In South Africa the Phosphate Development Corporation of South Africa (Foscor) has succeeded in producing a high-grade concentrate. Quarries under development have made available approximately 1,500,000 tons of higher-grade ore. Large reserves of low-grade ore are available.

Commercial production was expected to start in 1958 from the apatite deposits at Tororo, Uganda, which have reserves estimated at over 200,000,000 tons.

Egypt produced 605,000 l.tons of phosphate rock in 1956.

POTASH

THE metal potassium has little importance in industry, but its salts are widely used, the largest outlet being in fertilizers. Many potassium salts are consumed in the chemical industry and there are also important applications in other industries.

In recent years the most important producers of potash have been Western and Eastern Germany, France, the U.S. and the U.S.S.R., but Spain, Poland, Korea and Israel also have considerable outputs.

In Western Germany production of potash rose from 8,786,200 l.tons in 1950 to 15,853,000 l.tons in 1955 and 15,299,000 tons in 1956, while in the same period Eastern Germany increased its output of marketable product from 1,460,000 tons to 2,000,000 tons (K_2O content).

In 1938 North America was using about 500,000 tons of potash yearly, half of which was imported and the balance mined in the vicinity of Carlsbad, New Mexico. By the end of World War II North American consumption was 1,000,000 tons a year. It has since more than doubled.

Banking on a spectacular increase in demand, which so far has failed to materialize, the U.S. potash industry embarked on huge expansion programmes, which in recent months have raised output capacity to some 2,500,000 tons a year—20 per cent greater than current North American demand and double the Carlsbad capacity of a decade ago. Although annual sales are only in the region of $80,000,000, the industry includes such big mineral producers as International Minerals and Chemical Corporation, the British-owned U.S. Borax and Chemical Corporation, Freeport Sulphur and Phillips Petroleum.

U.S. potash producers have been gaining a bigger share of the world market, often at the expense of European competitors. Exports in the year ended May 31, 1957, totalled 236,532 tons, compared with 103,523 tons for the previous year. The principal customer is Japan.

In 1957, National Potash Co., jointly owned by Pittsburgh Consolidation Coal Co. and Freeport Sulphur, opened a mine and refinery at Carlsbad, with a designed annual capacity of 400,000 tons of high-grade muriate of potash. Two other newcomers to the industry have large mines under development or contemplated in this ancient sea bed.

It is in the Saskatchewan Province of Canada, however, that the biggest drive to uncover new sources of potash is now proceeding. The Canadian potash-bearing fields are estimated to cover some 3,000,000 acres. The reserves are currently estimated at 100,000,000,000 tons and are of higher grade than New Mexican potash. The Potash Co. of America is sinking a shaft on a property near Saskatoon, its surface plant having been completed in 1956. Last year International Minerals and Chemical Corporation began sinking the shaft for a new potash mine on a site of 450,000 acres near Esterhazy, about 150 miles east of Regina. Sixteen other companies are active in the 340-mile long potash belt, with development in the planning or exploration stages. During the next decade Saskatchewan may become the world's paramount producer of potash.

In September, 1957, potash output at the Dead Sea works plant, Sodom, in Israel, reached the record monthly figure of 7,800 tons. An annual rate of 150,000 tons has been suggested as a production target. The Geological Institute is investigating the possibility of commercial exploitation of an occurence of artesian water containing potash in concentration five times as great as that in the waters of the Dead Sea.

L. H. Manderstam and Partners have been appointed consultants for rebuilding the potash plant in Jordan at the north end of the Dead Sea. The plant is expected to cost £4,000,000-£4,500,000 to rebuild over a period of about five years.

The World Bank has made a loan equivalent to $75,000,000 for development in Southern Italy, of which a substantial amount will be allocated to three companies for the exploitation of rich potash deposits recently discovered in Sicily, which may prove to be among the world's largest occurrences. Two projects are in the province of Caltanisetta and the third in the province of Enna. All three include both the development of potash mines and the construction of fertilizer plants.

Despite the rapid expansion of production and the highly competitive conditions now prevailing, long-term prospects for the potash industry are regarded as excellent. Over a long period demand has been growing at a yearly rate of 6 per cent. If farmers increased their use of potash to the recommended level, any surplus capacity would be readily absorbed. Moreover, as farm lands become depleted of their plant nutrients, more potash will be needed to restore their fertility.

ANTIMONY *by Paul E. Grainger*

ANTIMONY has an extremely wide range of uses and it is probably of greater purely military value than any other metal except mercury. Certainly it was classified in the U.S.A. as the most strategic of all strategic minerals. In its metallic form it is essentially an alloying and hardening element, especially for lead in battery plates, cable coverings and other hard lead, and tin in white metal bearings, pewter and collapsible tubes. Its peculiar property of expanding slightly on cooling makes it indispensable in printers' type metal for obtaining sharp outlines. Applications of the chemical compounds range from ammunition primers and fireworks on the one hand to flame-proofing on the other, and include pigments, ceramics, camouflage paints, rubber products and medicines.

More than half the world's antimony ores are believed to lie behind the 'iron curtain,' principally in China, which pre-war was the main source of supply. World production, excluding U.S.S.R., was estimated by the U.S. Bureau of Mines to be about 49,000 tonnes in 1956, compared with 45,500 tonnes in 1955, including 12,000 tons in China and 1,600 tons in Czechoslovakia. All that is known of Russian production is that it is fairly large but insufficient information is available to permit even a "guesstimate."

Free World production generally declined in 1957 as demand slackened and low-priced Russian and Chinese metal came on to world markets in increasing quantities. Generally speaking, Bolivian and Mexican ores have a natural market in the U.S.A. with overflow to Japan, whilst South African ores come mainly to the U.K. Slackening U.S. and Japanese demand led to increased availability of Bolivian material in Europe.

In South Africa, output of Consolidated Murchison (Transvaal) Goldfields Development Co. Ltd., the world's largest producer, was 8,570 tonnes (Sb content) during Jan.-Sept., 1957 with an indicated total of approximately 11,000 tonnes for the year, compared with 14,233 tonnes in 1956. Bolivia exported 5,100 tonnes in 1956 but this probably declined slightly in 1957 as, for the second year running, no antimony was produced by the Mining Corporation of Bolivia. Other reported 1957 productions were: Mexico approximately 4,000 tonnes, Yugoslavia 1,770 tonnes and Algeria 1,380 tonnes; Turkey exported approximately 2,650 tonnes.

U.S.A. has little domestic antimony, mine production being 661 s.tons in 1957. Imports of ore (Sb content) rose 31 per cent to 8,636 s.tons, mainly from Mexico and Bolivia, but smelter production remained virtually unchanged at 10,064 s.tons. Metal imports were 20 per cent higher at 5,640 s.tons, mainly from the U.K. and Yugoslavia. Consumption of primary metal declined 20 per cent to 10,400 s.tons whilst recovery of secondary metal in antimonial lead and other alloys, the main source for metallic uses, dropped 26 per cent to 17,664 s.tons. Consumption of primary antimony included 3,500 tons for metallic uses and 4,190 for non-metallic uses, as compared with 5,374 tons and 7,531 tons respectively in 1956. End 1957 stocks of primary metal at U.S. smelters, distributors and consumers stood at 6,860 s.tons, approximately 1,000 tons lower than the previous year. On November 4, the Department of Agriculture added antimony to the C.C.C. Barter List.

Consumption of primary antimony in the U.K. declined 5 per cent to 4,622 l.tons, but recovery of secondary metal in alloys was 5 per cent higher at 4,454 l.tons.

The U.S. price of domestic metal, R.M.M. brand, f.o.b. Laredo in car-load lots, remained unchanged from mid-1955 at 33 c. per lb., but this was dropped to 29 c. in February, 1958. Foreign brands 99.6 per cent were quoted at 26-27 c. per lb. duty paid in 5-ton lots at end-year. Demand for ores was weak and the price of 65 per cent lump ore drifted from $3.90-$4.00 per unit in January to $2.90-$3.00 in December.

On November 1, the price of English 99.6 per cent grade antimony was reduced by £25 to £197 10s. per l.ton and 99 per cent grade by £20 to £190. These were the first reductions in the U.K. domestic price since November, 1953, but were considered long overdue both because of lower ore prices

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and increasing pressure from cheaper Russian and Chinese metal—even after allowing the 10 per cent import duty. Surprisingly, the price of Chinese 99.6 per cent was raised £3 on January 18, 1957 to £164-£166 c.i.f. where it remained for the rest of the year. Russian 99.9 per cent metal also was raised £5 per ton on February 15 to £165-£167, but it eased slightly in March and for the rest of the year was quoted at £165-£166.

The outlook for antimony remains weak. World production temporarily exceeds industrial requirements and adequate supplies from Free World mines with increasing offers of 'iron curtain' material indicate neither shortage nor higher prices in the near future—provided there are no political interferences in the principal mining countries.

QUICKSILVER

THE buyers' market for quicksilver, which had persisted throughout most of 1956, gave place early last year to a firmer trend. After starting the year at about £85, the price per flask ex-London warehouse hardened to £91 10s. by the end of June. In the second half of the year, however, buying interest again fell away and the London market was unsettled by large offerings of Mexican metal. Once these had been absorbed, and with the Italian and Spanish producers holding out for higher prices, the position again changed quite sharply, bringing a gradual recovery to £77-£78 ex-London warehouse, as quoted on March 6, from £69 at the beginning of 1958.

In the U.S. the price of quicksilver for domestic delivery ended 1957 at $225-$230 per flask, compared with an average of $260 per flask in 1956.

World production of quicksilver—estimated to have been about 200,000 flasks in 1957—is believed to be considerably above current consumption.

Exports from the Spanish mines of Almaden during 1957 totalled 47,931 flasks. A new deposit of mercury ore has been found near Torrejoncillo in Caceres Province, Estremadura.

Italy exported 992 tonnes of quicksilver in 1957 against 2,585 tonnes in 1956.

Mexico, the third largest producer, had an output of 19,531 flasks in 1956 and last year's production was expected to be only slightly lower. Yugoslavia produced 12,400 flasks in 1957.

U.S. mine production at 31,500 flasks was the highest in history, being 30 per cent greater than in 1956. New estimates of the domestic reserves of mercury ores of mineable grade have been made by the U.S. Geological Survey. The total reserves of all classes of ore now amount to 315,000 flasks, of which approximately half is measured or indicated and the remainder inferred. The rate of discovery is evidently keeping pace with production.

Total U.S. imports of quicksilver during 1957 amounted to 45,000 flasks against 52,009 flasks in 1956, the principal suppliers being Spain, Italy and Mexico. Consumption is estimated to have aggregated 54,000 flasks, almost unchanged from the 1956 total of 54,143 flasks. Substantial decreases in agricultural uses, electrical apparatus, and in the production of chlorine and caustic soda were offset by metal required to increase capacities at industrial installations using quicksilver.

Marketwise, the most notable development has been the formation of the joint sales office known as Mercurio Italiano by the two major Italian producers, Monte Amiata and Seile, together with Argos and Siam. Roura and Forgas Ltd. of London, who were agents for Amiata, have been appointed sole selling agents for the new concern in the sterling area and Western Germany.

Also of importance has been G.S.A's change-over to seamless flasks for quicksilver purchased from domestic and Mexican producers. The latter are paid $205 per flask (equivalent to about £73 5s.), being the G.S.A. buying price of $225 less U.S. duty of $20. Taking the average price of a conventional bottle at $1.50 and that of the seamless type at $6.50 and allowing a further $5 for possible rebottling costs, the net return to the Mexican producer is reduced to $195 (roughly £69 10s.) less transport. On this basis Mexican metal tends to be attracted to the U.K. at upwards of perhaps £71 per flask. The original G.S.A. programme terminated on December 31, 1957, but it was agreed that, due to the flask difficulties, metal for current delivery could be held and bottled up to March 31, 1958. A further programme was subsequently announced, under which it would be possible for U.S. mines to deliver up to 30,000 flasks in 1958 and Mexican producers up to 20,000 flasks.

The Outlook

In this uncertain period the short-term outlook for quicksilver is difficult to predict, the question of most immediate interest being whether Spain and Italy, the world's largest producers, are strong enough to maintain their asking prices. On the longer view, quicksilver's future is assured by the importance of this unique metal, to the expanding electronics, instrument and chemical industries.

BORON

FURTHER advances were made in 1957 both in the production of borax—the principal source of boron—and in the development of new applications for boron compounds.

The U.S. accounts for about 90 per cent of the total world output of borax, other producers including the Argentine, Italy and Turkey. It is believed that there are considerable deposits of borax in the Soviet bloc, but the extent of present exploitation is unknown. About 70 per cent of the known U.S. high-grade reserves belong to the British-owned U.S. Borax and Chemical Corporation, which is the world's largest producer of boron raw material.

To meet the steadily increasing demand, U.S. Borax and Chemical Corporation has established a new open mine and a new refinery in the Mojave Desert area of Southern California, which will raise U.S. output by 30 per cent. The new mine and plant were formally opened in November, 1957. Designed for a fully mechanical operation from pit to finished product, the project represented an investment of $20,000,000.

The largest users of boron compounds are the glass and ceramic industries. Borax is widely used as an ingredient in soaps and cleaning compounds, as well as in pharmaceutical preparations. Boron carbide, an excellent absorber of neutrons, is employed in atomic reactors for control rods and as a shielding material. It is also used as an abrasive and as a wear resistant material. A material harder than the diamond has been produced experimentally from boron nitride.

Besides the established uses, which are rapidly expanding, there is increasing commercial acceptance of new products. Among those in the early development stage are pure boron, a range of metallic borides, boron tribromide, and boron phosphate. Increasing tonnages of borates are being used in timber preservation.

The most dynamic possibilities for future expansion are presented by the development of fuels for aircraft and guided missiles based on boron chemicals. It has been stated that boron fuels enable an aircraft or missile to fly 40 per cent faster or further than on ordinary fuels. At this stage the extent of this potential market can only be guessed, but it is obviously immense.

In appealing for U.S. Government assistance in the form of an increased depletion allowance, the president of U.S. Borax and Chemical Corp. pointed out that production of borax had tripled in the past 10 years and would probably be at least doubled in the next decade.

FLUORSPAR

FLUORSPAR is used as a flux for steel-making; in the manufacture of synthetic cryolite used in the aluminium industry for the reduction of aluminium from its oxide form; in the ceramic industry; and in the chemical industry for the production of hydrofluoric acid. Other expanding uses of the mineral and its derivatives include high octane petrol production, uranium fluorides for atomic energy programmes, and production of high energy fuels.

World production, while remaining at a high level during 1957, was considerably lower than the previous year's output of 1,720,000 s.tons. There was also some contraction in demand.

The world's largest producer and importer of fluorspar is the U.S. In 1957 U.S. domestic production declined by about 2 per cent to 325,000 tons, while imports increased by 10 per cent to 620,000 tons. However, growing use is expected to increase domestic consumption to around 1,000,000 tons by 1960, a rise of 50 per cent. The problem of finding more fluorspar in the U.S. has been described as serious.

About half the fluorspar used in the U.S. now comes from Mexico, where the reserves are reported to be extremely large. Many small mines in the U.S. have been forced to shut down because they could not meet Mexican competition. Total exports from Mexico in 1956 amounted to 360,117 s.tons. Mexican producers remained very active in 1957.

In February, 1957, the U.S. Government announced plans to stockpile 250,000 tons of domestic acid-grade and 250,000 tons o metallurgical-grade fluorspar over a 2½-year period.

Canadian production in 1957 was expected to be considerably lower—possibly by one-third or more—than the 1956 mine output of 151,738 s.tons, due principally to the

suspension of operations by St. Lawrence Corporation of Newfoundland in the middle of the year. In August, 1957, Newfoundland Fluorspar Ltd., a subsidiary of Alcan, shut down its plant temporarily while improvements and extensions were made.

Western Germany produced 170,858 tonnes of crude fluorspar in 1956. At the current rate of production reserves, estimated at 2,000,000 tons, will last for another 10 years. Other major producers in 1956 included Italy 136,675 s.tons, the U.S.S.R. 110,000, East Germany 90,000, France 89,287, the U.K. 80,708, Spain 66,000 and Union of South Africa 35,065.

While the demand for fluorspar depends primarily on the level of activity in the steel and aluminium industries, long-term prospects appear to be very favourable.

BISMUTH

BISMUTH is obtained mainly as a by-product in the smelting of lead, copper, gold and silver ores. World production has been rising steadily and in 1956 amounted to 2,450 s.tons, which compares with 2,000 tons in 1955 and an average of 1,700 tons in 1947-51. The largest producers are Mexico and Peru, which in 1956 produced 695 and 316 s.tons respectively. Other important producers include the Republic of Korea (200 s.tons in 1956), Canada (136), France (71) and Spain (64). The metal is recovered as a by-product in the U.K., U.S.S.R., U.S. and Japan.

U.S. consumption was again higher in 1957, amounting to an estimated 800 s.tons, compared with 756 tons in 1956.

Throughout 1957 bismuth continued to be quoted in London at a nominal 16s. per lb. for pharmaceutical users and the prices of bismuth ores also remained unchanged.

Bismuth metal of Chinese origin became available in limited quantities on the European market during 1957.

Bismuth's main uses are as a constituent of fusible alloys and in the manufacture of medical and cosmetic preparations. The future outlook for bismuth alloys appears to be bright. Uses of the alloys are constantly being expanded and new applications discovered. The atomic energy industry is currently using some bismuth in liquid metal cooled reactors. It can be assumed that, if these reactors are successful and commercial power stations of this type are erected, bismuth will be in short supply.

SULPHUR

USED extensively in agriculture and industry and having no economic substitute, sulphur is traditionally regarded as a barometer of industrial activity. During the decade from 1945 to 1955, free world production almost doubled to about 13,500,000 l.tons, about 80 per cent of which was converted into sulphuric acid. In Europe, about 55 per cent of all sulphuric acid consumed went into fertilizing production, the corresponding figure in the U.S. being 40 per cent.

The pattern of the world supply of sulphur appears to be in the process of changing considerably, due to expanding production in Mexico and Canada. A position of threatened world shortage several years ago has given place to over supply.

Sulphur in almost pure state is found in domes mainly in Louisiana and Texas in the U.S., which country produces more than half the Free World output, and Mexico. This is mined by the Frasch hot-water technique. Central Italy and Sicily produce 200,000 tons annually of 17 to 35 per cent pure ore from domes which are mined by government subsidized open pit methods.

The chief producers of pyrite sulphur are Spain, Cyprus, Italy, Canada, Norway and South Africa.

Crude oil sources of sulphur are tied to oil and gas refining and usually supplement other sources. In recent years, high-sulphur-content natural gas discovered at Lacq, France, and in western Canada will meet most of the future local sulphur needs.

In the U.S., the demand for sulphur declined slightly in 1957, but remained near the record high of 1956. Actual consumption was down by about 5 per cent from the record 1956 consumption of 5,780,000 l.tons. Exports were estimated to be near the 1956 high of 1,650,000 tons. Production from all sources was estimated at 6,900,000 tons, compared with 7,820,000 tons in 1956, made up of 5,500,000 tons Frasch sulphur; 525,000 tons gas recovery; 425,000 tons pyritic sulphur; and 450,000 tons from other sources. Eleven Frasch mines remained in operation, one closed down, and three new deposits were under development, including the first completely off-shore sulphur mine at Grand Isle.

Mexican 1957 output was about 1,000,000 tons (86,000 tons in 1954; 516,000 tons in 1955) and is expected to be even greater in 1958. Because of Mexican competition, the main American producers dropped their

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price for top grade quality to $23.50 per gross ton, f.o.b. mine, in September, 1957. Based on a prediction of better business conditions in the second half of the year, it is believed that 1958 sulphur demand in the U.S. might equal that for 1957.

Known reserves of producing domes in the U.S. and Mexico are estimated to yield 60,000,000 tons and 30,000,000 tons respectively. An additional 75,000,000-100,000,000 tons are probably available in known domes scheduled for production by 1965. More off-shore reserves may be located. Ratio of reserves to production is expected to decline from about 15 years in 1955 to 10 years in 1965.

Canadian production of elemental sulphur rose to about 100,000 tons in 1957 compared with less than 35,000 tons in the previous year, mainly as a result of increased recovery from natural gas. An ultimate output of perhaps 1,000,000 tons annually is foreseen. Noranda Mines in 1957 completed construction at Cutler, Ontario, of its 1,000-ton sulphiric acid plant, which will use pyrites and pyrrhotite supplied from the company's operations in Quebec.

Rapid growth in European sulphur consumption is expected to continue and has been estimated at 7,000,000 tons and 8,700,000 tons in 1960 and 1965 respectively, compared with 5,300,000 tons in 1955.

A mine under construction at Piaseczno, Rzesnow voivodship, Poland, is being prepared to produce 1,900,000 tonnes of sulphur ore annually, yielding 350,000 tonnes of pure sulphur. Work on a second sulphur mine at Machow has been deferred for two years. It is estimated that, with both mines fully in operation, 1,000,000 tonnes of sulphur can be produced per year.

BARYTES

THE demand for barytes continued throughout 1957, by far the greatest consumption being for oil well purposes where it is used as a weighting agent for drilling muds. Other principal uses of barytes are in the manufacture of lithopone, as an extender in certain paints, a filler in the rubber, leathercloth and oilcloth industries and in the manufacture of barytes compounds and specialized explosives. There has also been a growing demand for barytes in aggregate form for use as a shield against radiation in atomic energy plants, X-ray buildings and laboratories.

Mining sources in this country centred mainly in the North of England and Scotland have not been able to meet the increased demand in the U.K., the bulk of the crude material being required for lithopone manufacture, and consequently much crude mineral has had to be imported from European countries and the North African Continent. As in past years the need for ground white barytes for the paint industry has had to be met by imports from Italy and Germany, but in the latter case a substantial reduction of imports has been caused by production difficulties.

The greatest world producer continues to be the U.S., which accounted for 1,160,614 l.tons in 1956 out of a world total of 2,560,000 tons. Western Germany produced 405,210 tons, Canada 264,570 tons and Mexico 210,592 tons. Other notable producers include Italy, Greece, Spain, Yugoslavia, Algeria and Morocco.

The total U.K. production in 1956 was 58,095 tons of barytes and witherite, while imports of barytes minerals and barytes compounds totalled 53,420 tons.

When all statistics are available world output in 1957 is expected to be perhaps 10 per cent lower than in 1956.

At Walton, Nova Scotia, a new shaft is being sunk to 729 ft. in a barytes deposit and a modern mill is planned. A new deposit in Nova Scotia is being prospected by the Magnet Cove Barium Co.

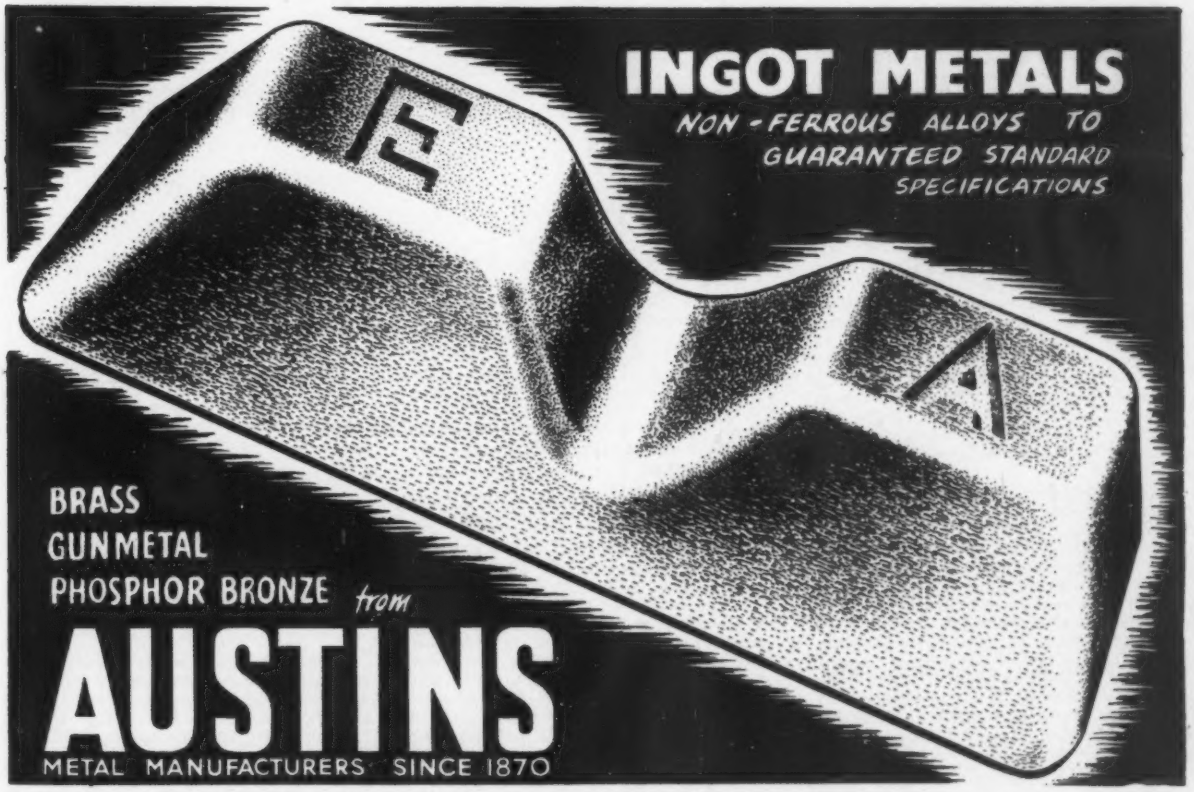
Mexico produced 360,000 tonnes of barytes in 1957 and hopes to produce 400,000 tonnes this year.

In Greece a mill for grinding barytes has been established jointly on the island of Mykonos by the Magnet Cove Barium Co. and the Mykonos Mining Co.

A new plant has started in Sardinia, where substantial barytes deposits have been found.

World consumption is largely governed by oil well drilling which is responsible for the greatly increased barytes production figures for the U.S., Canada and Mexico of recent years. A decline in oil well drilling or the recovery of oil well barytes for recirculation would see a marked decline in consumption. The U.K. position, however, is somewhat different, as none of the barytes raw material requirements are governed by the oil drilling industry. The outlook is, therefore, more promising and the demand likely to remain strong. Imports of ground white barytes to the U.K. are likely to remain steady due to the absence of suitable crude mineral to produce white barytes in this country.

World prices have continued to rise but prices of home produced barytes have remained fairly steady throughout the year.



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ASBESTOS

THE asbestos industry had another good year in 1957, with no falling off in total demand and production little changed from the 1956 world output of 1,295,000 l.tons, Canada again accounting for slightly over 60 per cent of the total.

The relative price stability of asbestos has been an important factor in the growth of the industry during recent years. The price level remained virtually unchanged from 1952 until the end of 1955, when an increase of approximately 5 per cent came into effect. In 1957, Canadian mining companies announced further increases averaging about 5 per cent on all grades of asbestos fibre, effective on October 1, which were necessitated by rising labour rates and production costs. The Canadian Johns-Manville quotation for No. 1 crude is now $1.470 per ton f.o.b. the mine at Asbestos, Que. U.S. fibre prices were raised by about 10 per cent, also effective from October 1.

Canadian Production

Deliveries of asbestos from Canadian mines rose by 2.9 per cent in 1957 to 1,048,084 tons from 1,017,848 in 1956, output reaching the record value of about $11,000,000.

Although current production and demand are approximately in balance, with a slight over-supply in a few particular grades, Canadian producers are vigorously proceeding with their vast expansion plans. A programme costing over $64,000,000 will result in the addition of 11,500 tons per day capacity with the completion of three new mines this year in the Eastern Townships of Quebec, where total reserves are placed at approximately 950,000,000 tons. This programme, together with modernization and expansion of older producers, will increase Canada's asbestos producing capacity to 59,700 tons per day.

Lake Asbestos of Quebec, a wholly owned subsidiary of American Smelting and Refining Co., New York, is developing an asbestos mine and building a mill that will produce about 100,000 tons of fibre a year. The project is unique in that the ore lies under a lake, which is a key feature in the drainage system of a populated area of very heavy rainfall. Preparing the deposit for open pit mining involves removal of about 37,000,000 cu. yds. of overburden. It is estimated that by the time production starts, $32,500,000 will have been invested in this project, including $9,200,000 for the mill.

The other two new producers are Carey-Canadian Mines, which is nearing completion of an $8,000,000—$9,000,000 project, and National Asbestos. The latter company is constructing a mill and preparing an open pit designed for production at a rate of 3,000 tons per day starting about mid-1958.

Among the existing producers, Canadian Johns-Manville is approaching completion of a $2,000,000 programme at Asbestos which will raise milling rate at its main mine to 800 tons per hour. The company is considering whether to develop its Jeffrey mine at Asbestos further or develop new ore bodies which it owns in Canada, and it is also exploring for additional deposits. Nicolet Asbestos has increased mill capacity from 2,500 to 3,600 tons per day, while the Asbestos Corporation is reconstructing its Beaver mill at Thetford Mines to increase capacity to 5,000 tons per day.

Extensive diamond drilling by Advocate Mines during 1956 on its 1.575 sq. mile concession in Newfoundland blocked out a very large tonnage of chrysotile, and this company is now seeking major financing to bring this deposit to production. The present plan provides for an initial output of 3,000 tons a day, the capital cost being estimated at $17,540,000. After four years production will be raised to 5,000 tons daily. Cassiar Asbestos Corporation has acquired options to purchase additional properties, two in the Yukon and one in Northern British Columbia.

Africa

Asbestos production in Southern Rhodesia rose to 132,124 tons in 1957 from 118,972 tons in 1956. Rhodesian asbestos mines are stepping up production of lower grade fibres in a determined attempt to break into new world markets. This follows the encouragement given to the industry by the waiving by the Southern Rhodesia Government of royalties on Grades 7 and 6. Waiving of the royalty means an increased profit margin for producers of about 28s. a ton on Grade 7 and about 36s. a ton on Grade 6. There is a strong world demand for lower grade asbestos.

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ASBESTOS • VERMICULITE • SILLIMANITE • GRAPHITE

ASBESTOS

THE asbestos industry had another good year in 1957, with no falling off in total demand and production little changed from the 1956 world output of 1,295,000 l.tons, Canada again accounting for slightly over 60 per cent of the total.

The relative price stability of asbestos has been an important factor in the growth of the industry during recent years. The price level remained virtually unchanged from 1952 until the end of 1955, when an increase of approximately 5 per cent came into effect. In 1957, Canadian mining companies announced further increases averaging about 5 per cent on all grades of asbestos fibre, effective on October 1, which were necessitated by rising labour rates and production costs. The Canadian Johns-Manville quotation for No. 1 crude is now $1,470 per ton f.o.b. the mine at Asbestos, Que. U.S. fibre prices were raised by about 10 per cent, also effective from October 1.

Canadian Production

Deliveries of asbestos from Canadian mines rose by 2.9 per cent in 1957 to 1,048,084 tons from 1,017,848 in 1956, output reaching the record value of about $11,000,000.

Although current production and demand are approximately in balance, with a slight over-supply in a few particular grades, Canadian producers are vigorously proceeding with their vast expansion plans. A programme costing over $64,000,000 will result in the addition of 11,500 tons per day capacity with the completion of three new mines this year in the Eastern Townships of Quebec, where total reserves are placed at approximately 950,000,000 tons. This programme, together with modernization and expansion of older producers, will increase Canada's asbestos producing capacity to 59,700 tons per day.

Lake Asbestos of Quebec, a wholly owned subsidiary of American Smelting and Refining Co., New York, is developing an asbestos mine and building a mill that will produce about 100,000 tons of fibre a year. The project is unique in that the ore lies under a lake, which is a key feature in the drainage system of a populated area of very heavy rainfall. Preparing the deposit for open pit mining involves removal of about 37,000,000 cu. yds. of overburden. It is estimated that by the time production starts, $32,500,000 will have been invested in this project, including $9,200,000 for the mill.

The other two new producers are Carey-Canadian Mines, which is nearing completion of an $8,000,000—$9,000,000 project, and National Asbestos. The latter company is constructing a mill and preparing an open pit designed for production at a rate of 3,000 tons per day starting about mid-1958.

Among the existing producers, Canadian Johns-Manville is approaching completion of a $2,000,000 programme at Asbestos which will raise milling rate at its main mine to 800 tons per hour. The company is considering whether to develop its Jeffrey mine at Asbestos further or develop new ore bodies which it owns in Canada, and it is also exploring for additional deposits. Nicolet Asbestos has increased mill capacity from 2,500 to 3,600 tons per day, while the Asbestos Corporation is reconstructing its Beaver mill at Thetford Mines to increase capacity to 5,000 tons per day.

Extensive diamond drilling by Advocate Mines during 1956 on its 1.575 sq. mile concession in Newfoundland blocked out a very large tonnage of chrysotile, and this company is now seeking major financing to bring this deposit to production. The present plan provides for an initial output of 3,000 tons a day, the capital cost being estimated at $17,540,000. After four years production will be raised to 5,000 tons daily. Cassiar Asbestos Corporation has acquired options to purchase additional properties, two in the Yukon and one in Northern British Columbia.

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Gems and Abrasives

DIAMONDS • EMERALDS • CORUNDUM

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DIAMONDS *By A Special Correspondent*

MINING highlights in the diamond producing industry last year included: (*a*) the increased scale of operations to a new world record; (*b*) the installation of more mechanical equipment for removal of overburden and for recovery of diamond from gravel; (*c*) the installation of sink and float methods of diamond recovery; (*d*) a new world record of diamond sales by the central selling organization; (*e*) the working of lower grade deposits; (*f*) the increased operations by African diggers; (*g*) new developments in South-West Africa, and (*h*) the discovery, prospecting and commencement of working of Russian diamond deposits. The repercussions of the latter, the production of synthetic diamonds in the U.S.A., the trade recession and the large scale of illicit diamond mining and diamond smuggling were all further subjects of concern to the diamond mining and marketing industries[1].

Economics

Another record for the sales of diamonds by the Central Selling Organization on behalf of the big African producers and others was announced early in 1958. The new figure, as seen in the accompanying table, means that each succeeding year since 1949 (with the exception of 1953) has seen a new record by value established. It will be seen from the figures that there was a small decline of £49,754 in the sales of industrial diamonds but that this was offset by the increase of £2,275,856 in the sales of gem diamonds. The new record was in part achieved by the increase of about 5.7 per cent in the prices of gems at the beginning of the year, and an increase of about 8.5 per cent in two classes of industrials.

The United States Government has stopped adding to its strategic stockpile of industrial diamonds, yet, at the close of the year, sales of industrials to the U.S. were maintained at levels which were nearly normal.

In spite of all this, there is by no means any great over-supply of diamonds to the world's markets. Both Israel and Federal Germany are habitually short of rough; the Middle East oil barons are said to have been buying diamonds as a hedge against inflation; it is believed that industry could easily absorb the production of the synthetics; and expanding industry in the U.S.S.R. might equally absorb Russian production which might even be inadequate (the U.S.S.R. is expected to require 6,000,000 ct. of industrials annually by 1960).

World Production

The mining of diamonds in 1957 was again on an increased scale for the seventh year running to a new record amount, according to reports received. The latest confirmed figures relate to the year before when a new record of about 23,000,000 ct. was produced, an increase of 2-3 millions or nearly 11 per cent on the previous year. The increase is largely attributable to the 1,000,000 ct. increase (+ 7 per cent) of the Belgian Congo, and the increase in the production of Ghana, Sierra Leone, South-West Africa, French Africa and of the exports of Liberia. The South American producers, British Guiana and Venezuela, however, both reported decreases in output. The mine value of world production of diamonds is estimated to be in the region of £65,500,000[2].

Algeria.—Diamonds are claimed to have been found by French prospectors in the Sahara, teams from the Algerian Mineral Research Bureau having been prospecting the Hoggar massif, 900 miles south of Algiers, since 1953. In less than three months, six diamonds have been found in the river deposits of the Silet region west of Tamanrasset, five of them being small with a fine bluish tint and the sixth, much larger, of industrial quality.

Angola.—Mining operations for the recovery of diamonds by Diamang were on an increased scale in the last financial year of the company, 7,493,287 cu. metres of soil (an increase of 23 per cent) being removed, 37 per cent by mechanical excavators, 33.1 per cent by hydraulic processes and 31.2 per cent by manual labour. The amount of gravel treated was 1,905,438 cu. metres, an increase of 29 per cent over the previous year. In addition to the traditional methods of treatment, sink and float is now in full operation, 606,632 cu. metres being processed for a recovery of 97,359 ct. Work on the hydro-electric plant at Luachimo is nearly completed, about £2,000,000 having been spent on it. Total output of the mines was 740,034.9 ct., a decrease of 3,342 ct. from the previous year.

Strong measures are being taken in Angola to combat illicit trading in diamonds.

Commencing at the end of 1957, the stones are to be sent to Portugal for processing instead of to England as previously, a Government supported industry having been established in Lisbon.

Australia. — Plans to prospect for diamonds on a large scale in Australia in the Inverell district of New South Wales by (the late) Dr. J. T. Williamson were rumoured early in 1957, but subsequently denied[3].

A very small quantity of diamonds is still produced in Australia annually as a by-product of working alluvial deposits for gold.

Belgian Congo.—Mining of diamonds in the Belgian Congo continued to be the largest operation of its kind anywhere in the world, and was responsible for the production of 60 per cent of world output by quantity. Since the output is largely of industrials (crushing boart), however, it is only 15 per cent by value.

La Forminière (Société Internationale Forestière et Minière du Congo), founded in 1906 through an agreement between the Chester Beatty mining finance group, the Congo Free State government and the Belgian Fondation de la Couronne, not only works its own concessions but also those of the Sociétés Minières du Kasai, Leubo, Lueta, and Bécéka. Forminière has thus been in existence for over 50 years but it has most of its original 99 years lease still to run.

Large capital investment in its property and plant was made during the year by the Bécéka company.

Brazil.—No figures of output of diamonds in Brazil have been available for some years and it is said that not a single carat is now exported legally. In one recent year alone, however, the U.S.A. imported $15,000,000 worth of diamonds from Brazil.

French West Africa.—Mining of diamonds in this territory is remarkably like that in Sierra Leone, in that there is a company operating under a proper concession, whilst in addition there is a large amount of illicit diamond working and smuggling. The major company, Soguinex, 36 per cent of whose capital is held by Sierra Leone Selection Trust, and slightly more than 36 per cent by the French Government, has been compensated to the tune of Frs.C.F.A.70,000,000 for its losses; moves are in hand to legalize the working of diamonds by Africans. It is proposed to

SALES OF GEM AND INDUSTRIAL DIAMONDS

Year	*Gems* (£000,000)	*Industrials* (£000,000)	*Total* (£000,000)	*Industrials* (% *of total*)
1946	26.1	3.5	29.6	11.8
1947	20.1	4.4	24.5	18.0
1948	26.8	11.3	38.1	29.6
1949	20.0	8.4	28.4	29.6
1950	38.3	12.6	50.9	24.8
1951	46.8	18.3	65.1	28.0
1952	45.8	23.8	69.6	34.3
1953	43.3	17.8	61.2	29.0
1954	45.6	16.5	62.1	26.7
1955	50.3	24.0	74.3	30.9
1956	50.5	24.0	74.5	31.1
1957	52.8	23.9	76.7	31.1

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establish a market like that in Accra, and there is to be an export tax of 18 per cent. A good deal of recent output has been exported via Liberia.

Ghana.—Mining of lower grade diamond deposits is to be undertaken by Consolidated African Selection Trust Ltd. which is planning to install an £800,000 washing plant; this is expected to be in operation by the middle of 1959.

The Geological Survey has been carrying out investigations into the evaluation of the alluvial diamond deposits without which adequate control over the African workings is difficult if not impossible. The source rock of the diamonds occurring in the Birim field appears to have been discovered in a breccia-conglomerate which has been weathered to considerable depths.

India.—Mining operations in the Panna region of Madhya Pradesh in Central India were characterized during the year by the nationalization of the mines and the decision of the Government, after a Russian report on the deposits and their operation, to mechanize the workings at a cost of about £4,000,000.

It is believed by the Geological Survey that all the diamond-bearing rocks of the former Hyderabad State may not have been exhausted and a more intensive programme of prospecting, including investigation in depth, has been recommended[4].

Liberia. — President Tubman has announced that enormous deposits of diamonds have been proved in Liberia and he has recommended proper regulation of their working, centralized sales and controlled exports. He did not refer to the disorders that have been reported nor to the exodus of workers from the plantations to the diamond fields. One of the first legislative steps to be taken is the imposition of a 9 per cent tax on the output of diamonds from the territory.

Sierra Leone.—Mining of diamonds when reckoned on a basis of value is said to be now on a larger scale in Sierra Leone than anywhere else in the world. The Diamond Corporation's purchases are estimated at about £5,000,000, and it is believed that some £10,000,000-£20,000,000 of diamonds were smuggled out of the country last year. The problems and issues arising out of diamond smuggling still continue to be a source of major concern to all who have the country's welfare at heart and various ways of overcoming smuggling have been considered. It has been suggested that the best way of getting revenue from diamonds is by a tax on the commodities that are bought with the proceeds from the diamonds.

The Diamond Corporation has been hampered by not being able to offer the world price of diamonds in Freetown because of the 7½ per cent export duty, expenses and the profit tax. Prices in Monrovia are 5 to 10 per cent higher and payment is made in dollars, which is worth another 7½ per cent.

The issue of licences to deal in and prospect for diamonds will be on a reduced scale during the current year, and it is expected that there will be a decline in the amount of smuggling in 1958.

Mining operations by the Sierra Leone Selection Trust Ltd. are to be extended by the installation of a new plant in Tongo.

Two officials of the Mines Department were dismissed after a Commission of Inquiry into the issue of alluvial diamond mining licences in the Gbambaidu area of the Kono district. As a result of the issue of these licences, permission was, in effect, given to work on areas belonging to the Sierra Leone Selection Trust Ltd. Better marking of the company's boundaries has also been recommended.

Diamond may not now be dealt in nor may anyone have diamonds in his possession in the 36 Chiefdoms on the boundary of the country with either Liberia or French Guinea, except with written official permission.

WORLD PRODUCTION OF DIAMONDS[3]

	Quantity (Carats)		*Value (£)*	
British Countries	1955	1956	1955	1956
Ghana	2,258,270	2,539,429	5,452,000	7,948,765
Sierra Leone	418,077	549,811	1,567,787	2,934,000
Southern Rhodesia	—	—	—	—
South-West Africa	812,848	987,599	13,809,000	18,000,000(*b*)
Tanganyika	325,523	358,717	3,228,212	2,864,714
Union of South Africa	2,628,917	2,585,728	12,671,880	12,665,931
British Guiana	33,300	29,816	280,952	268,344
India	1,787	1,499	30,400	24,525
Australia	731	383	5,600	3,067
Total	6,479,453	7,052,982	37,046,000	44,700,000
Foreign Countries				
Angola:				
Gem diamonds	441,789	443,280	4,272,000	4,266,000
Industrial diamonds	301,588	296,755		
Belgian Congo:				
Gem diamonds	628,298	626,969	1,675,000	1,474,000
Industrial diamonds	12,413,199	13,383,509	7,863,000	9,116,000
French Equatorial Africa	136,958	145,837	822,000	890,000
French West Africa	318,520	389,880	1,098,900	1,224,000
Brazil(*b*)	250,000	250,000	(*a*)	(*a*)
Venezuela	141,147	93,833	946,000(*b*)	924,000
Total	14,631,000	15,630,000	17,677,000	18,894,000
World's Total	21,110,000	22,683,000	54,723,000	63,600,000

(*a*) not available (*b*) estimated

South-West Africa.—The year's developments were characterized by a major legal battle for a declaration of diamond rights on the South-West African coast to Consolidated Diamond Mines of South-West Africa. The administrator of the territory had granted a concession over 170 miles of the coast between high water mark and a point 800 yd. into the Atlantic ocean, to another company. The action took place at the end of 1957 and was dismissed by the high court; an appeal has been lodged.

South Africa.—Mining policy of De Beers to work mines according to requirements is continued in the temporary closing of the Bultfontein mine and the re-opening of the Wesselton mine[5].

The company is installing a £2,000,000 washing, crushing and recovery plant, which is expected to come into operation in August 1959. It will be located at a central site to the two shafts of Bultfontein and Wesselton. The Bulfontein shaft is being reconditioned as well as modernized by the installation of electric winding equipment. Ore from the Dutoitspan mine, which is being increasingly worked by block caving, will be conveyed on the 1,900 ft. level to Bultfontein for hoisting.

In Namaqualand, the principal areas of diamond production continued to be the State Diggings at Alexander Bay and the workings at Kleinzee at the mouth of the Buffels River. The latter deposit is nearly worked out, but the Minister of Mines has said that there were promising prospects of new fields being located along the coast.

Tanganyika.—The chief event recently was the death at the age of 51 of Dr. John Thorburn Williamson, the owner of the fabulous mine at Mwadui. The company is registered in Tanganyika where the estate is liable for duty at 40 per cent if it is over £2,000,000 in value. The Mwadui mine is responsible for 90 per cent of Tanganyika's output of diamonds and 9 per cent of annual world sales.

Mining and economic policy regarding the mine are likely to continue in the same tenor as recently, because of the very large capital expenditure in mining equipment made in recent years and the agreement of the company with the Central Selling Organization regarding the sale of its output.

The new plant began its first full year's operation in 1957, and in spite of teething troubles, was treating three times the quantity of gravel as previously. The plant, with a capacity of 7,000 to 7,500 tons per day, employs heavy media separation and grease belts fed by a 10,000 ft. conveyor belt from a 6½ cu. yd. electrically-operated walking dragline. The new plant is recovering diamonds with greater efficiency, as shown by the 11 per cent increase in quantity of output and an 11 per cent decrease in value[6].

U.S.S.R.—Reports of the existence of diamonds in various parts of U.S.S.R. have been current at least since 1898, but only within the last year has an authoritative account been given of the newly discovered diamond fields in Yakutia, Siberia. These were brought to light as a result of a large scale programme of prospecting of the Lena-Yenisei divide subsequent to the finding of a minute diamond (0.012 gm.) on the Lower Tunguske River in 1948. The first kimberlite pipe was discovered in 1956 in the headwaters of the Markha River, and since then many others have been found mostly in the basin of the RiverVilyui, where there are two groups of pipes some hundred kilometres apart. There are also alluvial

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fields of economic tenor further north in the basins of the rivers Olenek and Muna.

The largest diamond from the Vilyui field so far is one of 32¼ ct., but extremely small diamonds preponderate, the average weight being 10 to 15 mg. in the pipes and 10 to 25 mg. in the alluvials; gem diamonds are rare.

Mining of the placer deposits will be impeded by the climate since there are only five months of the year above freezing point.

The discovery of the Yakutia fields is a major triumph, and the availability of industrial diamonds to the Russian economy is a factor of great importance, but the statements that the fields compare in importance with those of Africa and that the U.S.S.R. will soon be an exporter of diamonds, appear to be premature on present evidence.

Early in 1958 it was claimed that rapid progress had been made toward producing the 600,000 ct. of industrial diamonds per year required by Soviet industry[7].

Other Territories.—Prospecting and the issue of licences relating to diamonds were reported during the year in a number of countries including Nigeria, the Sudan, Kenya, Uganda, China, and Columbia. There have been no major mining developments in any of these and little or nothing has been heard during the year of the diamond industries in Basutoland, Borneo, or Southern Rhodesia.

Research and Development

Scientific and technical research on diamond in 1957 included investigation of its minor element content, frictional and adhesion properties, inclusions, thermal expansion, artificial coloration, its occurrence in meteorites and locating imperfections.

A method of "finger-printing" diamonds so that a particular stone can be identified has been developed by the diamond laboratory of the London Chamber of Commerce using a technique of photography in ordinary light and in ultra-violet light[8-12].

Synthetics and Substitutes

Production of synthetic diamonds by the General Electric Co. in 1958 is expected to be about 3,500,000 ct. At present these synthetics are some 40 per cent dearer than boart, but the price was recently reduced to 24s. 10d. per ct. The average synthetic diamond is less than $\frac{1}{10}$ of a ct. in weight and rarely more than $\frac{1}{16}$ in. long. Both France and Japan are said to be experimenting with the production of synthetic diamonds.

Following on the previously announced production of Borazon (boron nitride), the G.E.C. has announced the production of another extremely hard substance, boron phosphide. It is easier and cheaper to make than synthetic diamonds or Borazon[13].

Obituary

The diamond industry lost a number of notable personalities during the year through death; notably Sir Ernest Oppenheimer, the man who did more than any other to establish a stable diamond market[14]; Dr. Paul Grodzinski, the man who did so much to further the use of industrial diamonds[15]; and Dr. J. T. Williamson, discoverer and operator of the famous diamond mine in Tanganyika.

EMERALDS

A DISCOVERY of emeralds was made in Southern Rhodesia by a mining company searching for base minerals in the Mweza Range of hills, outside the Belingwe Native Reserve. In collaboration with the company, the Government arranged for the small mineralized pocket containing the emeralds to be placed under police protection and declared an area surrounding the find to be reserved against prospecting. No mining is at present taking place, as sufficient stones were discovered on the surface to meet the immediate requirements of the emerald market. The find remains the property of the company. The emeralds so far discovered are of high quality, a particular feature being that the small ones retain their colour when cut.

GARNET

THE term "garnet" is given to a group of closely related silicate minerals, which are used solely as abrasives. For many years more than 90 per cent of the world supply has come from the U.S., which is also the largest user.

During 1956—the latest year for which comprehensive statistics are available—abrasive garnet sold or used by producers in the U.S. fell to 9,812 s.tons valued at $1,073,386 from 11,835 s.tons worth $1,191,456—a decline of 17 per cent in output and 10 per cent in value. In the peak year 1954 the U.S. garnet output totalled 14,183 s.tons worth $971,353.

Garnet's chief rival in the woodworking trade is the artificial abrasive aluminium oxide, U.S. production of which remained substantially unchanged in 1956 at 195,228 tons of abrasive grade material.

Spain produces about 200 l.tons of garnet annually; Egypt, Madagascar and Argentine each produce about 150 tons. Small tonnages are produced in Australia and Ceylon.

CORUNDUM

NEXT to the diamond corundum is the hardest natural mineral known and it is to this property that it owes its industrial importance as an abrasive. Its principal application is in grinding optical lenses.

Despite increasing competition from artificial aluminium oxide, world production expanded from about 3,000 tons annually before the Second World War to 11,000 s.tons in 1956. During the decade ended in 1940, practically the entire world supply came from the North-Eastern Transvaal, but the Union of South Africa has now been displaced by Southern Rhodesia as the largest producer. In 1957 the output of S. Rhodesia rose to 4,506 l.tons from 4,448 tons in 1956. South Africa produced 1,537 tons in 1957 and 2,068 tons in 1956.

Transvaal Corundum Co. Ltd. reports promising results from experiments with its grain corundum. Initial production of abrasive stones for testing purposes is under consideration.

Apart from the U.S.S.R., for which no data are available, the only other countries producing corundum in 1956 were India 395 s.tons and Malaya 100 tons (exports).

A company was formed in 1957 to exploit the garnet deposits at Namaputa in Masasi District, Tanganyika, and trial shipments were made. The quality of the garnet is known to compare well with standard commercial grades of this abrasive material.

Imports of corundum into the U.S. during 1956 were 1,857 s.tons valued at $83,141—an increase of 33 per cent in quantity but a decrease of 14 per cent in value from 1955.

EMERY, PUMICE, & TRIPOLI

EMERY is usually defined as a natural aggregate of corundum and magnetite. The largest application is a non-skid component in stair treads, floors and pavements.

Before emery was discovered in Turkey in 1847, the world's entire supply came from the island of Naxos in the Greek Archipelago, one of the largest of all deposits. In 1956 Greece produced 7,000 l.tons of emery (9,000 in 1956) and Turkey 6,282 l.tons (6,987). Sales of emery by U.S. domestic producers increased in 1956 to 10,857 l.tons worth $174,032 from 9,585 tons worth $151,455 in the previous year, being a rise of 13 per cent in quantity and 15 per cent in value. These three countries produce almost all the Free World output.

Pumice and pumicite are essentially vesicular silicates of aluminium. The term pumice is usually applied to the lump product, while pumicite is used for a fairly fine volcanic ash first found in Nebraska, U.S.A., but subsequently located on an extensive scale in Canada and New Zealand. The chief source of lump pumice is the Italian Lipari Islands. It is claimed that ground pumice is three times as efficient as an abrasive than pumicite.

No statistics regarding Italian production of pumice are available. Western Germany's production of "crude and washed" pumice totalled 7,829,000 tonnes in 1956 and that of "marketable" pumice 3,598,000 tonnes. U.S. production in 1955 amounted to 1,804,488 s.tons. In 1956 Greece produced 25,000 tonnes, compared with 30,000 tonnes in 1955. New Zealand produced 7,614 l.tons in 1956. There is also a small production by Egypt.

The chief use for tripoli is as a mild abrasive, particularly in buffing and polishing compositions. Other uses are in washing powders, foundry facings, and as a filter in paint. Commercial deposits of good quality material are not common, the largest being in the U.S. which is the leading world producer. Smaller quantities are produced in France, Germany, Portugal and Spain. In 1956 the U.S. produced 43,338 s.tons of tripoli, valued at $1,616,855, of which 32,189 tons were of abrasive grade. Spain and Portugal produced 9,744 l.tons and 1,773 l.tons respectively in 1956.

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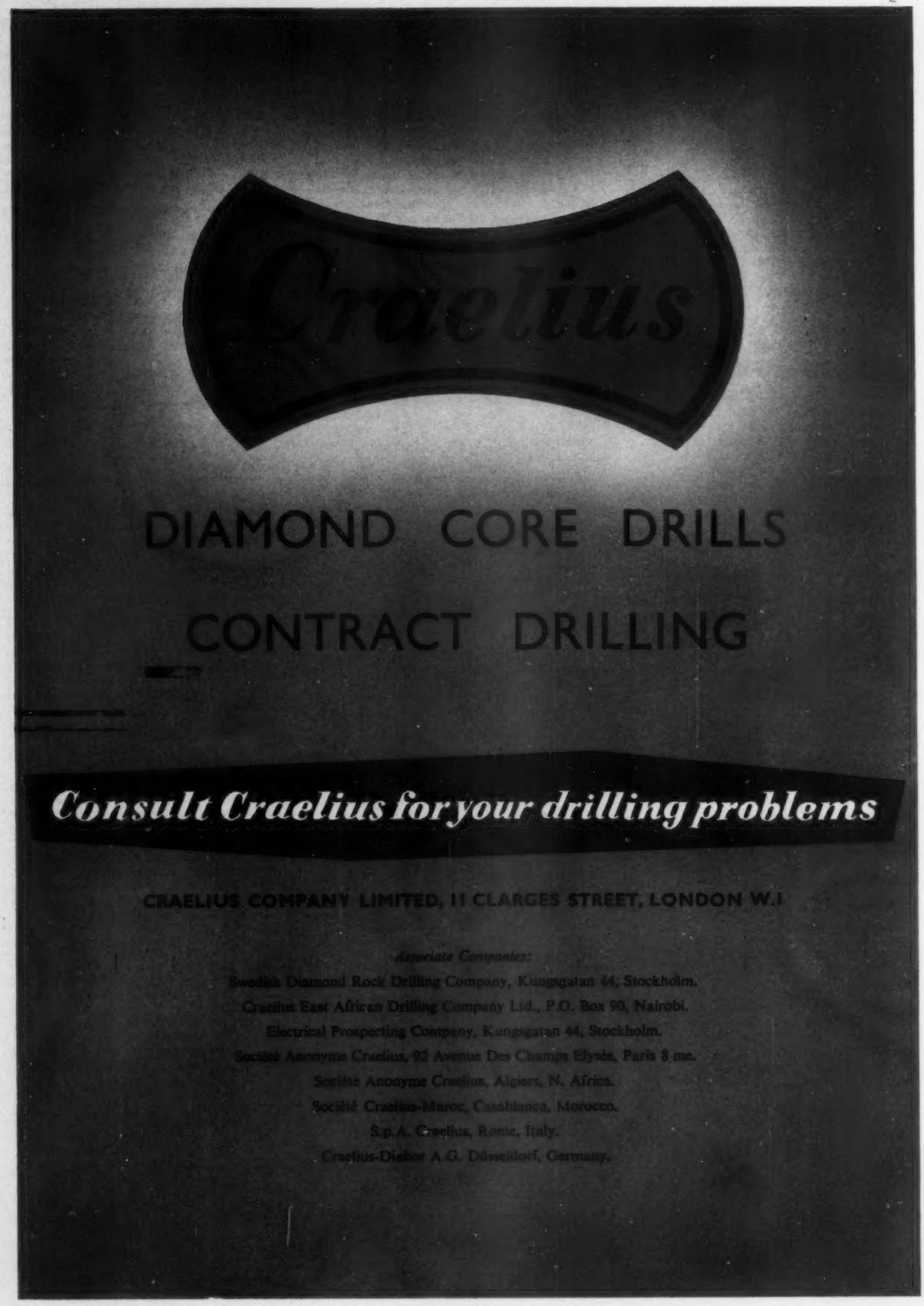
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Mineral Exploration

NOTWITHSTANDING the temporary surplus of metals, which brought a setback to various sections of the mining industry during 1957, the search for minerals continues to be vigorously prosecuted and is covering a progressively wider area. An appreciable slackening of activities was noted in the U.S., where some companies actually disbanded their exploration departments during 1957, but in Canada, Africa and elsewhere, the tempo of exploration shows little sign of slowing down and is even tending to increase.

In general, the larger mining companies are pushing ahead with their prospecting programmes with undiminished confidence that, whatever the immediate situation, the world's expanding requirements will absorb all the minerals and metals that can be made available in the years ahead. There has also been no diminution in the world-wide search for oil, which will not, however, be discussed in the present article.

The contraction in markets and prices has inevitably resulted in some slackening of activities by smaller companies and individual prospectors, but this trend must also be attributed to the high cost of the changed approach to exploration, whereby thousands of square miles are intensively explored by both geophysical and geological methods. So vast and so costly are some of the current projects that even the larger companies have joined forces to carry them out. Nevertheless, the individual prospector continues to play an essential part in exploration.

Among the highlights of 1957-58, exploration-wise, were the start of the £100,000,000 50-nation International Geophysical Year research project; and Dr. Fuchs' epic crossing of Antarctica.

The object of the I.G.Y. project, on which the U.K. is spending an estimated £650,000, is the gaining of greater knowledge about the physical phenomena occurring on the earth and in the atmosphere surrounding it. This immense co-operative effort, which ranges from the launching of rockets and satellites to Antarctic exploration, may throw new light on the nature and origin of mineral deposits and may also lead to new techniques of value in minerals exploration.

Antarctica

On January 19, Dr. Vivian Fuchs and his party of British explorers, arrived at the South Pole, thus completing the first stage of a trans-continental journey which ranks among the finest achievements of Antarctic exploration. The expedition's route across the continent was very carefully prospected. Both the geologist's hammer and the geiger counter were in constant use, while seismic observations were taken every 30 miles. The evidence obtained should go far to confirm or disprove the Gondwanaland theory (*The Mining Journal Annual Review* 1955, p. 81), according to which South America once fitted into the west coast of Africa, while Antarctica—before it split apart—filled in the gaps between Africa and India.

Geologists of the New Zealand Antarctic Expedition, under Sir Edmund Hillary, discovered an extensive coalfield in the Ross Dependency. Working from the joint New Zealand-U.S. base at Cape Hallett, this expedition has been mapping the little-known territory of the Ross Dependency, one of its aims being to establish the geological connection between east and west Antarctica.

During 1957 a British firm photographed 40,000 sq. miles of the Antarctic Continent on behalf of the Governor of the Falkland Islands, thereby becoming the first company to achieve a systematic aerial survey of any extensive part of this continent.

Canada

The geophysical approach to exploration is particularly stressed in Canada, which spent 40 per cent of the world's total expenditure on geophysics in 1956 and may have exceeded this figure in 1957. For many years this Dominion has also carried out extensive photogrammetric mapping.

Delegates to the Sixth Commonwealth Mining and Metallurgical Congress at Vancouver in the autumn of 1957 were impressed by the extent to which every modern tool is being employed in exploration, especially airborne instruments. They found that aircraft had become completely part of the everyday thinking of Canadian mining. Mining companies either have their own aircraft or rely on the services of the various chartered companies.

In the Ungava base metal belt, concessions have recently been granted to over 30 mining companies, which have commissioned airborne geophysical surveys to cover around 3,000 sq. miles at a cost of about $300,000. Another company estimates that it has found at least $900,000,000 of ore in the last two years by aerial work costing $2,500,000. Even when ground costs are added, this compares favourably with conventional exploration outlays.

The most intensive claim staking rush in Saskatchewan since the early days of the uranium strikes was sparked off on July 12, 1957, when the Saskatchewan Department of Mineral Resources distributed two sets of maps covering magnetometer and electromagnetic surveys of northern areas. Airborne magnetometer and airborne electromagnetic surveys of an area near Lac La Ronge were completed in June, this being the first electro-magnetic survey conducted by any Canadian government. The maps were intended to interest prospectors and to speed up development of the area. In northern Manitoba a party will carry out the aero-magnetic mapping of another unmapped area in the Canadian Shield. The Nova Scotia Government has offered large mining concessions to anyone who will undertake aero-magnetic and electromagnetic surveys.

There is also growing interest in Canada in the correlation of many kinds of information to produce more effective regional geological maps. An outstanding example is "Operation Overthrust" (*The Mining Journal Annual Review* 1957, p. 81), which is described as a compilation, study and re-appraisal of the geology of some 405,000 sq. miles of the Precambrian Shield of Canada and the central U.S. This survey, which is being undertaken for a large group of private companies, is expected to take the equivalent of 40-50 engineering man-years.

During the summer of 1957 the Geological Survey of Canada embarked on a geological reconnaissance of 100,000 sq. miles in the western district of Mackenzie, North-West Territories, where lies the vast and little explored frontier land of the oil and gas industry of Western Canada. The region to be surveyed embraces the drainage basin of the upper Mackenzie River. The equipment includes two Bell 47DI helicopters, provided with floats for operating on the plains and with skids for the mountainous terrain; and a De Havilland Beaver equipped with ski-wheels at the beginning of the field season and with floats following break-up of the ice.

In Operation Fort George, the Geological Survey of Canada will map by helicopter from 35,000 to 40,000 sq. miles of a 300-400 mile block of Quebec lying between latitudes 52 and 56 deg. and extending from the Hudson and James Bay coast inland to longitude 68 deg. This is part of the largest unmapped area in the Canadian Shield. The operation is a two-year project.

In Nova Scotia and New Brunswick, the Survey will carry out extensive geochemical surveys, analysing stream and lake waters, soils, and the sediments laid down by streams as a means of locating and outlining areas likely to contain deposits.

The Canadian Government plans to spend $6,000,000 photographing the Canadian Arctic for detailed mapping purposes. The photography will cover 500,000 sq. miles and will require the services of a dozen planes for six years.

Throughout the Dominion promising showings are being energetically explored by mining companies. In Saskatchewan several prospects are to be further investigated. A copper-zinc prospect near Brabant Lake has been singled out for intensive development. The La Ronge area is due for increased exploration with Rio Tinto interests in the van. In the north-east area of the province a number of prospects are being examined.

In northern Manitoba, the development of the Mystery-Moak Lakes nickel deposits by Inco has stimulated interest in adjacent holdings. A number of anomalies at Wintering Lake, which have been indicated by air survey, are to be drilled this year (1958) by Rio Canadian.

In Ontario a molybdenite prospect in the Sioux Lookout area is being drilled by Rio Canadian, while the potentialities of the Savant Lake area are being examined by Northern Canada Mines. In the Mine Centre district of north-western Ontario Noranda is carrying out geophysical work and trenching on a copper prospect. Several companies have been working in the Mattagami Lake area in Quebec.

In north-western Quebec the recent discovery of huge iron ore deposits near Whale River, on the east shore of Hudson Bay, has attracted widespread interest. British capital is financing exploration in the Noranda area, where drilling is being undertaken by Consolidated Zinc Corporation of Canada. In the LaMotte township of the province two companies are reported to be interested in further development of a nickel prospect. Some 100,000 acres have been staked in the

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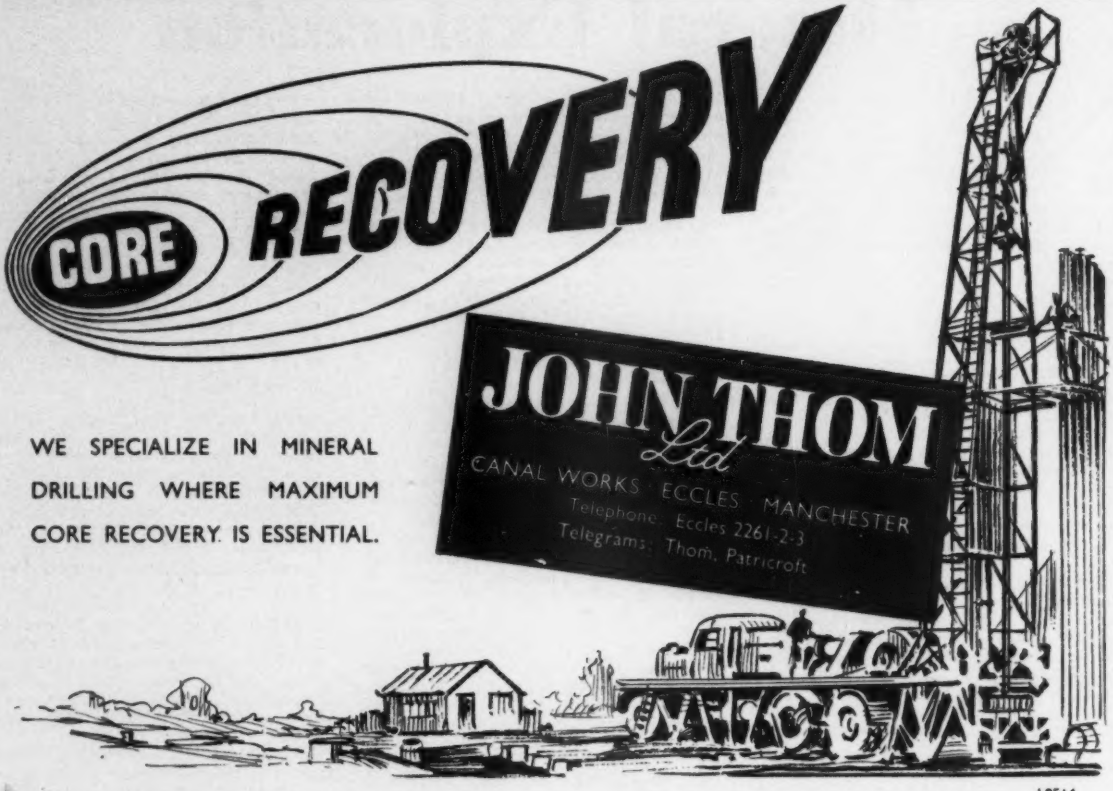

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Eastern Townships of Quebec, where a major gold rush was started by the discoveries at Chaudiere River.

Fundamental research into the hows and whys of mineral formation is now receiving attention in the work of the Geological Survey of Canada. It is hoped that this research activity will result in a considerable saving of time and expense to prospectors.

The United States

In the U.S., private companies and Federal and State surveys have been carrying out a considerable amount of geophysical work and geological mapping in order to select areas for exploratory drilling. A number of important orebodies were discovered or extended in 1957.

Exploration for uranium was less active than during the previous year. On October 28, 1957, it was announced that the point had been reached where it was no longer in the interest of the U.S. Government to expand production of uranium concentrates. As a result of this announcement, many of the smaller companies suspended exploration and development. Nevertheless, available reserves—estimated at 67,240,000 s.tons on June 1, 1957—are still regarded as inadequate to meet prospective peacetime uses of uranium. By 1959, U.S. mills will be grinding about 7,000,000 tons of ore a year to produce between 15,000 and 18,000 tons of uranium oxide.

Most of the large U.S. companies carried out intensive air and surface exploration for disseminated deposits of copper, both at home and abroad, and several important occurrences came to light in 1957. At Christmas, Arizona, 16,000,000 tons of ore containing 1.8 per cent copper have been developed by Inspiration Consolidated Copper Co. Phelps-Dodge, American Smelting and Refining Co., and Kennecott Copper Co. have taken over large blocks of ground for exploration in the Highland Valley area of British Columbia, where very large quantities of disseminated ore have been found by drilling. Elsewhere in this area diamond drilling by Canadian Exploration Ltd. on the property of Craigmont Mines Ltd. north of Merritt has revealed outstanding copper values. Hole No. 15 over a total vertical distance of 610 ft. revealed values averaging 4.52 per cent copper.

Important iron ore developments in the U.S. have been reported, among them being the discovery of three centres of iron ore deposition near Bonne Terre, Mo. One deposit has been sufficiently drilled to indicate a very large tonnage of commercial-grade iron ore at depths between 1,400 and 3,000 ft. Magnetite deposits in Alaska are being examined by U.S. Steel.

During 1957, phosphate deposits reported to be of great geological interest were being explored in Beaufort County, North Carolina. The phosphate occurs in beds of friable sands at depths ranging from 40 ft. to over 150 ft. below the surface. Since the surface is usually from 5 to 50 ft. above tide water level, mining presents formidable technical problems.

Vanadium Corporation of America has completed arrangements whereby it will conduct both underground exploration and drilling on behalf of other companies for the purpose of developing carnotite ore in the Ambrosia Lake district, New Mexico.

In June, 1957, the Secretary of the Interior stated that the ore potential resulting from 291 mineral exploration projects certified by the Department's Defence Minerals Exploration Administration was estimated to be worth $490,000,000 based on December, 1956 prices. This represented about $50,000,000 worth of new ore in the ground for each $1,000,000 of Federal Funds invested in these projects. The ratio decreases to about 23 to 1 when all contract disbursements made under the D.M.E.A. programme are compared with the value of ore potential. Under this programme, Federal funds are used to finance part of the exploration on approved projects, the extent of Government participation depending on the mineral commodity involved.

South and Central America

A deposit of autunite has been located in Minas Gerais, Brazil. Prospecting is still in progress and the extent of the deposit is not yet known. On December 26, the Brazilian Ambassador signed an agreement in Washington authorizing U.S. researchers to search for uranium in Brazil.

It has been authoritatively stated that, of the 8,500,000 sq. miles of Brazilian territory, some 3,000,000 have so far had no geological exploration of any sort.

Harvey Aluminium of America have leased over 600 sq. miles from the Jamaica Government and now have a team in the field engaged in prospecting. At Mavis Bank, about 18 miles from Kingston, the capital, preliminary surface stripping continues to bear out estimates by International Metals Ltd. of deposits of high grade iron and copper ores in commercial quantities.

In the Dominican Republic, efforts are being intensified to promote further exploration of mineral deposits. Extension of the iron ore mining concessions now operated

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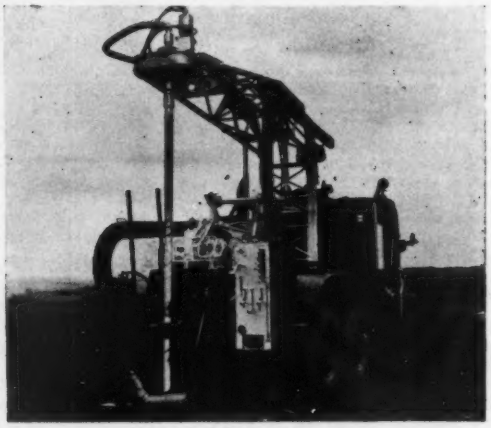

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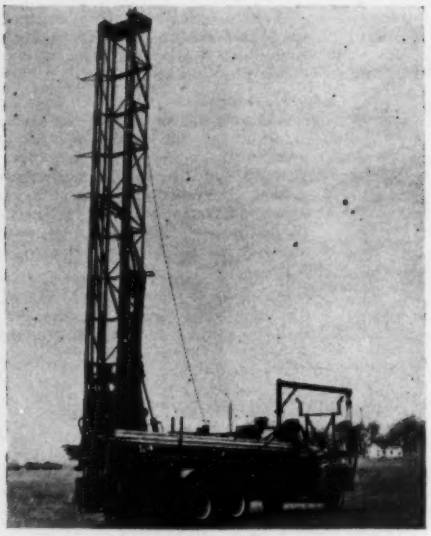

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by Barium Steel Corporation has been announced and this company has been granted an exploration permit to search for iron ore in eight provinces. Canadian interests are prospecting in the interior for deposits of nickel ore, believed to exist in substantial quantities.

The type of terrain over which a Saharan survey is being flown

By courtesy of Hunting Aerosurveys Ltd.

Africa

Reports from the Union of South Africa state that during 1958 a major effort will be made to uncover the mineral resources of the eastern Orange Free State, which, it has been suggested, may prove to be one of the richest areas in Southern Africa. An option over 400,000 acres has been taken by a leading mining company.

In the Northern Cape Province, Rhodesia Railways are looking for a group of companies that will prospect for and mine all minerals in the Vryburg and Kuruman areas, over which they hold the mineral rights. The successful applicant will be given exclusive rights to prospect and mine all minerals over about 6,600 sq. miles. On an average, a total of £100,000 a year will have to be spent in prospecting the entire area for a period of five years.

A new geological laboratory has been opened in Salisbury, Southern Rhodesia, by the Rhodesian Selection Trust group.

During 1957 the U.K. Atomic Energy Authority commissioned Hunting Geophysics Ltd. to carry out an airborne scintollometer survey over the degree square 29E 30E 17S 18S in Southern Rhodesia. This work was carried out with remarkable expedition, the results being plotted on 1/50,000 maps on which areas of anomalous radioactivity were shown. This led to considerable prospecting activity, but so far no worthwhile find has materialized.

Orders granting exclusive rights to prospect for uranium to Anglo American Rhodesian Mineral Exploration in three areas of Southern Rhodesia have been announced. They are for two years and the company is required to spend a minimum of £6,000 on prospecting in each area and to adhere to an approved programme.

A geological survey being conducted by Rio Tinto (Northern Rhodesia) Ltd. on behalf of the Rhodesia-Katanga Co. has achieved results which justify more intensive exploration. This Rio Tinto subsidiary is also conducting a programme of intensive exploration of the mineral resources of certain areas covering approximately 12,000 sq. miles in Northern Rhodesia, over which it holds exclusive prospecting licences.

In Tanganyika, the extensive aerial prospecting operations, which were an outstanding feature of 1956, gave rise in 1957 to much detailed prospecting on the ground. The mineral resources of a large and remote area in the Western Rift Valley are to be explored in a comprehensive aerial and surface prospecting programme launched by Western Rift Exploration Co. Ltd. This company has been formed by Anglo American Corporation of South Africa Ltd. and some of its associated companies, together with the British South Africa Co., Tanganyika Concessions Ltd., and the Newmont Mining Corporation. With an authorized capital of £1,000,000, it has taken over a special exclusive prospecting licence from the Anglo American Prospecting Co. (Africa) Ltd.

The area to be systematically explored for all types of mineral occurrences covers 34,000 sq. miles, stretches for about 300 miles north and south, and is bounded on the west by the shores of Lake Tanganyika. A unique feature of the operation is the concentration of different prospecting methods employed. It is intended to make a complete geological map of the area based on expert interpretation of air photographs followed by surface investigations to confirm and extend the interpretation. The geochemical method, which it is proposed to use, will be on the widest scale.

A fairly promising discovery of uranium and thorium has been found in the Northern Province of Nyasaland. Thorium-bearing sands are also being prospected at Monkey Bay and on the east coast of Lake Nyasa. In the Mwanza area, near Tambani Mountain, New Consolidated Gold Fields is carrying out an extensive search for radioactive minerals.

In the Sahara, where the oil has now begun to flow, the search for other forms of mineral wealth is also yielding encouraging results. The Algerian Mining Research Bureau has reported discoveries of diamonds, platinum, nickel and copper, these finds being made during a three-month search in the mountainous Hoggar region, 1,250 miles due south of Algiers.

In Egypt, geological missions have been examining deposits of manganese in the Sinai Peninsula, which are estimated to contain enough for an annual production of about 100,000 tons of ore. Recent discoveries of copper ore in the Sinai Peninsula are also claimed to be substantial, but prospecting will not be completed for a further two years.

Australia

The Australian Atomic Energy Commission has noted a substantial reduction in the activities of prospecting and mining companies and of individual prospectors searching for uranium. Formerly 18 companies were active in this field, but now only five companies and a few syndicates are actively occupied with uranium, four of the companies being in the Northern Territory and one in Queensland. The Commission has expressed concern that the present scale of activity is not greater. Large areas of Australia are geologically favourable to the occurrence of uranium, but only a fraction of these have been investigated with any thoroughness. It is feared that too slow a rate of exploration at this stage could prove a serious handicap to development in the future.

There has been some increased activity in prospecting for gold, but the industry continues to urge that assistance provided to producers by the Federal Government should be on a sufficient scale to encourage prospecting for new deposits, as well as exploration of existing mines.

Consolidated Zinc Pty. Ltd. is investigating the abandoned Astrolabe copper field near Port Moresby through its subsidiary Enterprise Exploration.

The greatly expanding demand for iron and steel in Australia is resulting in an intensified search for new iron ore deposits. The Broken Hill Pty. Co. is examining extensive deposits in the Northern Territory and in the far north of Queensland, but it is believed that these are of lower grades than the deposits now being worked by that company in South Australia and Western Australia. The company is opening up the Iron Baron deposits in the Middleback Ranges, South Australia. Reserves of high-grade hematite are comparatively limited, but it is believed that drilling at the Iron Monarch mine, further north, has shown substantial extension of ore at depth. The region contains very large quantities of taconite.

In order to stimulate prospecting for manganese ore and build up reserves, the Commonwealth Government has permitted a proportion of the ore located to be exported.

Asia

A meeting of the United Nations Economic Commission for Asia and the Far East (E.C.A.F.E.) heard India, Malaya, Japan and British Borneo report on the outcome of their searches for uranium and other radioactive minerals. A report from the Indian delegation outlined the occurrence of uranium and thorium in Rajasthan, Bihar, West Bengal, Madras and Kerala, and described deposits of heavy mineral sands containing thorium. The Indian Department of Atomic Energy has made

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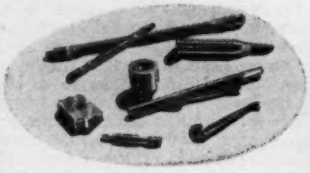

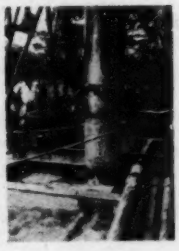

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an initial exploration of the shallow seas off the Kerala coast, proving the existence of mineral sands on the sea floor.

The Indian Government has decided to fix a ceiling on the area for which prospecting licences can be granted to private parties. This ceiling is likely to be 50 sq. miles.

Steps are being taken by the Government to ascertain whether deposits of iron ore and chromite in Salem district, Madras State, are sufficiently large to admit of large-scale exploitation.

Recent surveys made by geologists in the Quetta and Kalat regions of West Pakistan have revealed deposits of chromite, high-quality iron ore, copper and manganese, and indications of gold in the Chagai district, on the borders of Afghanistan. The Pakistani geologists are being assisted by experts from the Geophysical Institute in Quetta, established by the Government with the help of U.N.E.S.C.O. experts. During their operations, they use aerial photographs taken by the Photographic Survey Corporation of Canada, under the Colombo Plan. Maps now being prepared in Canada from the photographs will provide a basis for planning future surveys.

The Atomic Energy Commission of Pakistan has launched the second round of its search for radioactive minerals. Selected teams have been sent to cover Baluchistan and the North-West Frontier.

The possible development of mineral resources in Burma was discussed in Washington as part of a programme for stimulating interest on the part of American enterprise in investment abroad. A proposal was made for a co-operative exploration of Burma's promising mineral potentials.

An aerial survey contract to photograph 200,000 sq. miles of territory in Burma was awarded to Fairey Air Surveys, of London, and its associated company Air Survey of India (Pte.) Ltd. Valued at £200,000, this is believed to be the largest contract for aerial photography ever signed between a government and a private firm.

A Canadian aerial survey team is assisting the Government of Ceylon to investigate areas in which the radioactive mineral, thorianite, is known to occur.

The U.S.-South Korean Combined Economic Board announced that American and Korean engineers would shortly conduct a large-scale search for mineral deposits in South Korea. The programme includes a survey by airborne magnetometer. There has been no scientific survey in South Korea to determine mineral resources.

In order to secure raw materials Japan has stepped up its search for mineral resources in South-East Asia, Middle and Near East, and Latin America. For this purpose it was proposed to organize an Overseas Underground Resources Development Association, which would send survey teams overseas. Teams of Japanese experts are conducting surveys on mineral resources in various countries, many of them in response to requests from the governments of the countries concerned.

The Geological Bureau of the State Planning Commission claims that the latest surveys of China's mineral wealth indicate potential reserves of coal at 1,000,000 million tons and of iron ore at 12,000 million tons. It is further claimed that prospecting during the first Five-Year Plan has established that China has the world's richest potential reserves of tungsten, molybdenum and antimony, as well as abundant reserves of manganese, lead, zinc, aluminium, magnesium, sulphur and phosphates. Promising finds of gold have been made not only in the traditional gold belt of Northern Manchuria but also in the provinces of Sinkiang and Mongolia.

Jordan was reported to be considering granting Poland a concession for the exploration and exploitation of iron ore. It is believed that, in addition to iron, copper and phosphate, large deposits of gold and silver exist in the Maan district of southern Jordan. The U.N. Secretariat has approved the lending of U.N. experts to Jordan to advise on prospecting for metals and minerals.

Europe

A D.C. aircraft equipped by Hunting Geophysics with magnetometer, electromagnetic detector and scintillation counter has been carrying out a survey in Cornwall covering a distance of 4,300 line miles. The contract was awarded by the Department of Scientific and Industrial Research on behalf of the Geological Survey of Great Britain, in association with the U.K. Atomic Energy Authority. Cornwall was described as a suitable area for such a survey, not only because of the presence of sulphide and uranium-bearing deposits, but also because it would serve as a testing ground for the technique of discovery employed.

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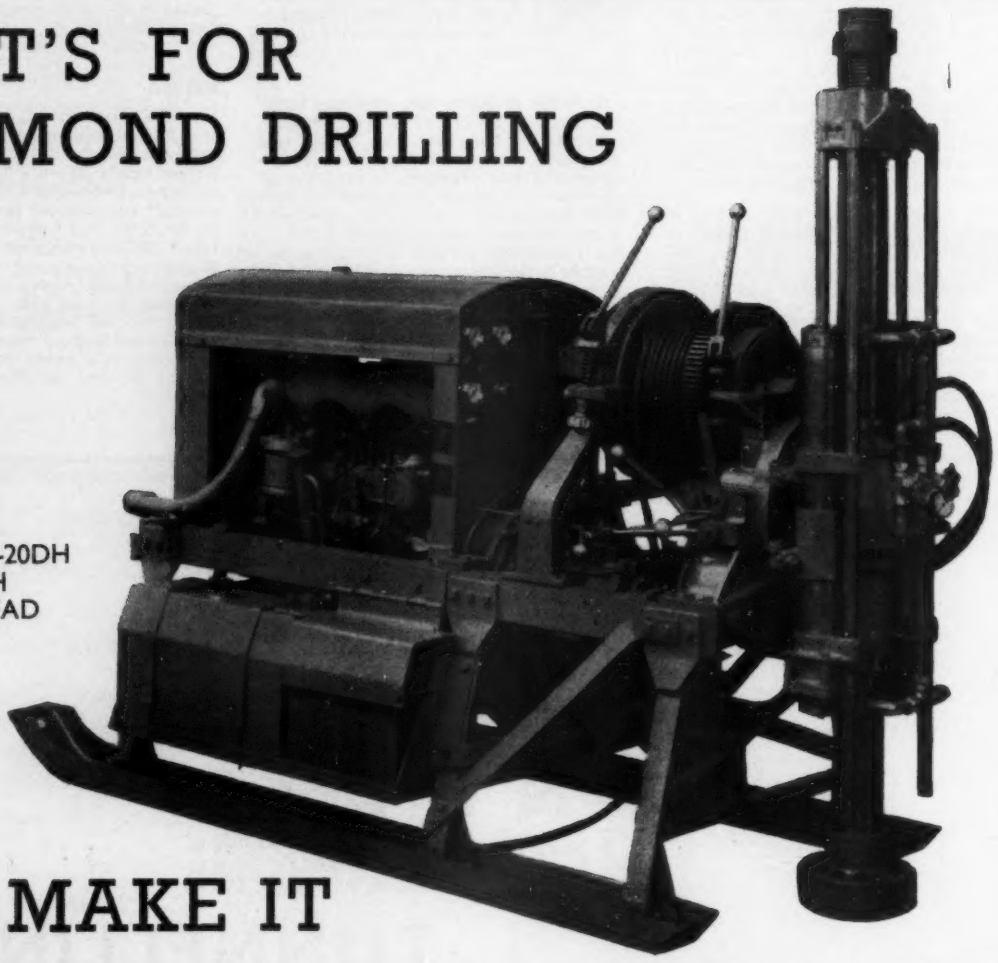

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With the object of discovering more sulphide ore and associated mineral deposits, a similar contract was given to the same company for an aerial survey in the Huelva district, Spain.

Large seams of copper have been mapped out in Poland in the regions of Boleslawow and Zlotoryja, as well as on the border of the Wroclaw and Zielona Gora voivodships. Prospecting continues apace and deposits found in the region of Sieroszowice and Lubin have assayed an average copper content of 1.4 per cent. Drilling has shown them to cover an area 22 km. long and 6 km. wide.

A widespread geological survey for new mineral deposits is to be carried out by the Hungarian Geological Institute. In the Mecsek Mountains, southern Hungary, hard coal deposits are under examination. Investigations in the region of Matra, northern Hungary, which have already led to the commercial development of non-ferrous metal deposits, are being continued. A search for manganese will be undertaken in the Bakony Mountains.

The U.S.S.R. now claims to lead the world in prospected deposits of essential minerals, including iron and manganese ores, coal, copper, bauxite, nickel, tungsten, lead, mercury, mica, zinc and potassium salts. Prospecting continues to be vigorously undertaken.

Techniques and Equipment

Lundberg Exploration Ltd. has developed an airborne gravimeter or gradiometer, which has been successfully used in trials over known gravitational anomalies, including orebodies. The difficulty presented by the motion of the aircraft, hitherto considered insuperable, has been overcome by the use of two suspended masses, the distance between which can be made to vary in proportion to the vertical gravity gradient. This system eliminates the effect of local topography in addition to that of aircraft movement.

In November, 1957, the first successful surface measurements of gravity in the open sea were performed by Dr. J. L. Worzel of the Lamont Geological Observatory, operating from the U.S.S. *Compass Island*, 200 miles S.E. of New York.

In Port Phillip Bay, Victoria, the Bureau of Mineral Resources of the Department of National Development is using a purchased underwater gravimeter to make measurements of the force of gravity on the bay's sea-bed. The instrument, which cost £A15,000, is enclosed in a massive steel bell which is lowered from a ship to the sea floor. It is levelled by electronic means and read by remote control. The instrument can take measurements in water to a depth of 600 ft. to an accuracy of one in a hundred million.

A simple and extremely rapid method of identifying mineral ores was demonstrated in London. The technique, which was developed by members of the Atomic Energy Division of the Geological Survey of Great Britain, enables nearly all types of minerals to be identified without recourse to spectrographic or X-ray methods. It involves the measurement of reflectivity and hardness. The equipment used consists of an electric cell photometer and a G.K.N. bench type hardness tester.

A new lightweight geiger counter, produced under licence from the U.K.A.E.A., combines high sensitivity with simplicity of design and an extremely long life of batteries. The unit utilizes a halogen-quenched tube of 6¼ in. effective length in a simple integrator circuit, using no valves or transmitters. Designed primarily for the detection of radioactivity and rough mapping, it is suitable for a wide range of applications from reconnaissance surveying and prospecting to routine industrial monitoring. Simplicity of design and construction has permitted the marketing of this tool at a fraction of the price of existing counters.

To aid engineers and prospectors exploring for heavy mineral deposits, metallurgists at the Southern Experiment Station of the U.S. Bureau of Mines at Tuscaloosa, Alabama, devised an inexpensive method by which core samples can readily be evaluated in the field. The process employs acetylene tetrabromide, which causes lighter minerals to float and permits the heavier ones to sink. Precise recovery of the heavier minerals can be accomplished.

A new electronic method of prospecting for ore deposits is being developed in Sweden by Bolidens Gruv Aktiebolag in collaboration with the Swedish Geological Institute. Operation of the method depends on the use of radio waves having a wavelength in the region of 80 metres. The equipment was used during development trials to locate substantial iron ore deposits in the Maurliden Mountains in Norrland. It is said to be able to locate such deposits at depths of up to 300 metres in mountainous country.

A one-man portable walking magnetometer for rapid measurement of the vertical component of the earth's magnetic field has been developed by a Canadian firm.

Overseas Geological Surveys

THE year was marked by the attainment of independence by Ghana and Malaya. Despite their withdrawal from the orbit of the Directorate of Overseas Geological Surveys, they showed a desire to maintain connection with many of the services offered by this organization.

The Director and his staff visited East, Central and West Africa, Malaya, Borneo, Solomon Islands, Fiji, Australia, Washington and Canada to examine developments, give specialist help and attend conferences. The Mineral Resources Division of the Directorate was responsible for many laboratory investigations on materials sent in from the various territories and also for the publication of the quarterly journal "Overseas Geology and Mineral Resources" and the annual "Statistical Summary of the Mineral Industry."

The number of geologists, geophysicists and chemists on the staffs of Overseas Surveys (17 in number) amounted to 207 despite the withdrawal of Malaya and Ghana. It is hoped that recruiting this year will serve to fill the vacancies remaining on the staff lists. There are about 20 posts still to be filled.

Two successful holes were recorded in the drilling for petroleum in the coastal area of the Eastern Region, Nigeria, and arrangements were put in hand for the export of the supplies.

A low phosphorus iron-ore deposit was found in the extreme north-east corner of the Ankole district, Uganda, which lies very close to the new westward extension of the railway. Another iron-ore deposit has been discovered in Nyasaland.

New carbonatite discoveries continue to be made in the African territories which will be the subject of close examination in the near future. The successful working of these areas however must await a livening of the markets for rare earths and, particularly, niobium. The considerable metallurgical research being carried out in niobium in the United States, one hopes, will result in a greatly increased demand for that metal in the future.

Very important occurrences of coal have been discovered in Swaziland. The main seam varies in thickness from 4 ft. 6 in. to 15 ft. and is all of mineable quality. The coal is of export grade and is classified as semi-anthracite.

The year was marked by the signing of two agreements to work deposits originally discovered by Overseas Geological Surveys; the first concerned the manganese of British Guiana, and the second the bauxite of Sarawak.

Helium was discovered in 1954 in the springs of the North Mara and Musoma areas of north-east Tanganyika and preparations were in hand to examine the occurrences by drilling. New, light, easily maintained, transistorized rate-meters have been distributed to the Overseas Surveys which should make possible the testing for radioactive materials of all areas visited by geologists.

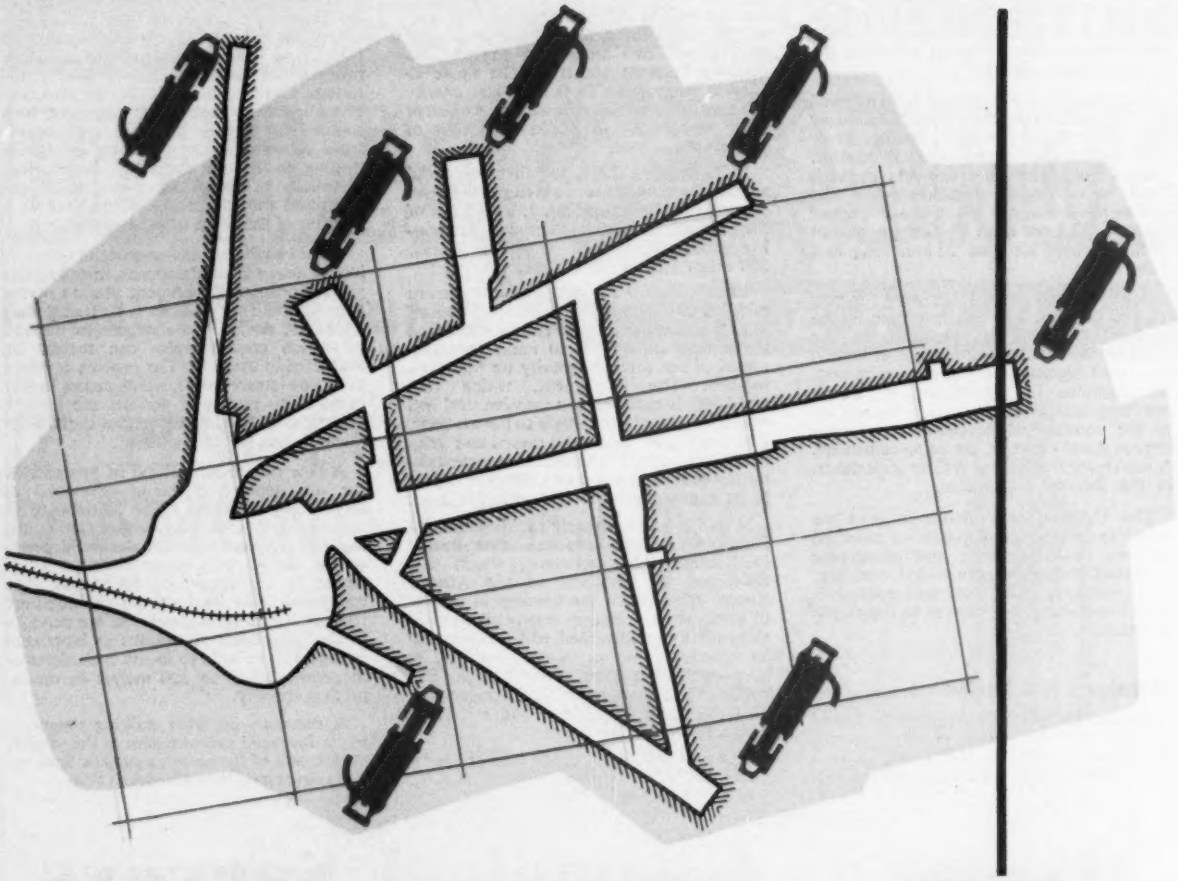
The Geological Survey of Jamaica was responsible for an investigation into the serious earthquake which occurred there on March 1, 1957.

The Mineral Resources Division carried out extensive laboratory investigations on cement materials from Tanganyika and from Northern Rhodesia, phosphates from the Solomons and gypsum from Somaliland, as well as on many other rocks and minerals. An X-ray set has been installed to assist in the work.

As usual much attention was paid to surveys of water resources in the various territories. A special survey was undertaken by a geophysics team from headquarters of some of the coastal alluvium of Malaya in this respect.

Photogeological interpretation of the geology of Nigeria, Tanganyika, Borneo and Somaliland was carried out at the section housed at Tolworth. Interesting and promising results have been obtained from the geochemical investigation in the various territories which has been carried out with the co-operation and guidance of the Geochemical Research Centre at the Imperial College of Science and Technology.

Members of the geological staffs of various universities carried out research in Sierra Leone, Uganda, the Solomons, Fiji, British Guiana, Tanganyika, Nyasaland and Northern Rhodesia.



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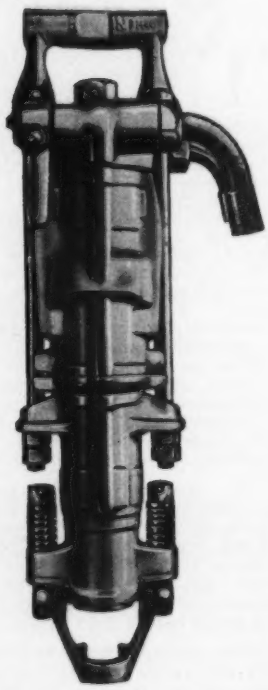

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HJ39

Underground Mining

By A. GRIERSON, B.Sc., M.I.M.E. and D. SUTTON, B.Sc., A.R.S.M., A.M.I.M.M.

THE past year in the mining industry has been one of readjustment to a reduced world demand for minerals, with a change of emphasis from expanding production to increasing efficiency. Expenditure on research and development has grown and a better understanding of some of the industry's complex problems has led not only to the design of more suitable equipment but also to greater safety.

DRILLING

In hard rock mining the first link in the production chain is nearly always the percussive drill, and this position is not likely to change in the foreseeable future. It is hardly surprising, therefore, that this method of drilling should continue to attract so much attention from research workers, engineers and metallurgists, all seeking to improve its inherent inefficiencies.

Beginning at the bit and working back to the machine, it is first of all worth recording that premature TC failures are disappearing and some operators have found that the normal life of the insert now exceeds the average life of the drill rod. Tapered attachments continue to gain in favour over the screw-on type, aside from long hole work where screw-on bits are still used exclusively.

Percussive Drill Steel

A wider understanding of the factors affecting life of drill steel is enabling operators to obtain more use from standard materials and manufacturers to produce improved alloys, better designs and new treatment processes.

Excessive stress concentrations resulting from poor mechanical design of shank ends, forged collars, rod couplings and the like are common causes of failure which no amount of metallurgical refinement can eliminate altogether. Good design is typified by avoidance of sharp changes in cross section throughout the entire length of the drill string, accurately ground and generously radiused shank ends, use of reverse buttress rather than rope threads in couplings, provision for definite rod-to-rod contact at couplings, and so on. Due attention to design is essential if any real benefit from improved steel is to be realized, but given good design the need for better materials is at once apparent.

Drill steel fails due to the progressive enlargement of micro-cracks originating in the surface, either in the water hole or outside, and due primarily to tensile stresses. These are set up during the drilling operation by reflection of compressional waves and by flexing of the rod, but high residual tensile stress may also be present in heat-treated portions of carbon steel. Stress is concentrated by surface imperfections which may be present in the as-rolled rod or introduced later by corrosion or abuse.

Another factor which plays an important part is steel hardness, since steel strength, fatigue resistance, and ability to transmit impact energy all increase as hardness is increased. Obviously then, processes designed to even out surface irregularities and at the same time give rise to residual compressive stress in a hard, tough, surface layer without adversely affecting other properties of the steel will result in increased drilling life. Several such processes have been applied to drill steel in recent years, and use of steel so processed is growing rapidly.

Mechanical surface treatments such as shot peening and spiral rolling, referred to in these pages two years ago, are designed to improve drill steel life by developing residual surface compressive stresses. This effect is also accompanied by some hardening by cold working.

Metallurgical surface treatments which raise surface hardness and leave the surface under residual compression include carburizing and surface hardening by induction or flame.

An example of the application of combined mechanical and metallurgical treatments is the carburized and shot-peened drilling rods which have been available in America from Gardner Denver for the past two years. These rods are offered in sizes from $\frac{7}{8}$ in. hex. up to $1\frac{1}{2}$in. hex. and are claimed to give outstanding performance, particularly in longhole work.

So far no mention has been made of corrosion, which invariably reduces the fatigue strength of wet percussive drill steels, and causes earlier breakages. In last year's *Annual Review* the large importance of this factor was indicated, and since then a new solution to the problem has been offered by Atlas Copco in the form of a chemical surface treatment known as the "SR" treatment. It is claimed that this practically eliminates fractures originating in the water hole and substantially reduces outside fractures before being worn off. SR treatment is stated to protect both the wall of the flushing hole and the outer walls of the steel from corrosion by a thin but strongly adhesive chemical layer, so causing the fatigue properties of the steels to correspond to those valid under dry conditions. On the wall of the central hole the SR layer is everlasting and does not decrease the diameter of the flushing hole. This represents an improvement on the lining of the central hole with stainless steel, more especially since stainless steel has a lower fatigue strength than alloy drill steel. Perhaps the claim most likely to appeal to mining men is that the new SR treatment imparts 50 per cent longer life to Coromant steel.

The advent of factory-applied surface treatment processes, difficult or impossible to reproduce in the mine drill shop, calls still further into question the already doubtful advisability of re-working worn or broken drill rods. Once a properly designed and carefully heat-treated rod has failed in service, it is likely to be in an advanced state of fatigue throughout its length, and if re-working is contemplated as an accepted routine it is advisable to weigh carefully the cost of repair against the value of additional service so obtained.

However, many mines still prefer to manufacture their own drill rods from standard alloy steel stock. In order to cater for average drill shop facilities the Crucible Steel Co. of America, in conjunction with the Ingersoll-Rand Co., have developed a Mn-Cr-Mo alloy steel designed for relative insensitivity to temperature and quenching variations over a wide range.

A shallow groove rolled along the entire length of the bar has been suggested by B. F. Shepherd, chief metallurgist of the Ingersoll-Rand Co., as a useful method of identifying different types of drill steel in circumstances where confusion might arise. Such a marking is not destroyed by use, and modifications of it such as an interrupted groove, coded dash-dot, double groove, etc. are easily devised to identify as many different types of steel as a particular case demands.

Experimental work carried out by the Gardner Denver Co. and reported by F. R. Anderson, assistant manager, indicates that 70 to 90 per cent of the energy available in the hammer of a percussive drill is lost between shank and bit. Several pertinent factors require further elucidation, e.g., how much of this apparent energy loss is due to inefficient transfer from piston to shank and from bit to rock—but it has been shown that transmission of impact energy is more efficient by the harder steels—a further point in favour of alloys.

Reducing the Life of Drill Steel

In the minds of many, drill steel is a semi-indestructible material made for a tough job and therefore capable of surviving the roughest treatment. This, of course, is grossly fallacious, since only those steels which are kept in quite perfect condition both before and during use ever reach the ripe old age of which all are potentially capable.

Common malpractice in the handling of steel has been analysed by Atlas Copco who, based on world-wide experience, have prepared a statement setting out a number of methods all highly effective in reducing the life of drill steel. The following methods are mentioned:—

1. Storing steels in the open.
2. Handling steels abusively.
3. Forgetting to regrind the steel.
4. Ignoring re-grinding instructions.
5. Running the drill with too low thrust.
6. Using too much thrust.
7. Using a drill with worn out rotation mechanism.
8. Using worn out chuck and piston.
9. Using steels for scaling.

All mining men will admit that these practices ought never to occur but few maintain that they never do.

Air an Efficient Flushing Medium

Tests conducted under the direction of B. G. Fish, N.C.B. Research Establishment, Isleworth, have shown that in all methods of small hole drilling lower thrusts are required for a given penetration rate when using air instead of water as the flushing medium. From this it is concluded that air is more effective than water for this

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A full range of rayon-carcass conveyor belts is available from Goodyear for applications where higher tension ratings are desirable. The special advantages of Rayon belts make possible a fresh approach to new installations, and also help to eliminate many difficulties with existing installations.

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The thinner construction ensures better troughing and less dead weight on highly-rated belts. The higher grades of rayon belting have ratings away above anything that is practical in cotton construction, and yet trough perfectly.

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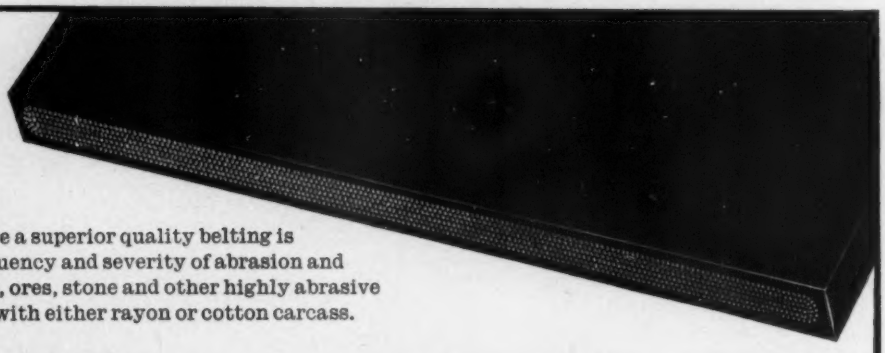

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purpose. Furthermore, in percussive drilling bit wear is lowered appreciably by using an air-flush method. In drilling by the rotary percussive method, however, bit wear is increased, this apparently contradictory factor being attributed to the higher bit temperatures generated. In rotary drilling, bit wear does not appear to be influenced by the choice of flushing medium, which is taken to indicate unsatisfactory temperatures even with water flushing.

Dust suppression was shown to be good using the Holman or Hemborn systems and with the dust either extracted through the drill rods or collected by means of a cowl over the collar of the hole.

Widening Application of "Down the Hole" Drill

There are signs that the down-the-hole drill is moving underground and being applied to both larger and smaller holes.

The down-the-hole principle is so basically sound that its more general adoption is anticipated for such works as the drilling of pilot holes for raises, horizontal cut relief holes in tunnels, holes for drainage, cables, fill, supplies and so on. Penetration rates in hard rock are far higher than can be achieved by calyx or diamond drilling, and the thrusts required are not so high as with the roller-cone method.

A down-the-hole hand drill, available in the U.S.A. from the Powermite Drill and Tool Co., is capable of putting in horizontal holes to a depth of 35 ft., but the anticipated application of down-the-hole drilling to long blast hole stoping is still awaited.

New Machines and Novel Ideas

A patent has been obtained in the U.S.A. by C. E. Sears of the Ingersoll-Rand Co. for a design of drill steel collar that is readily attachable and detachable.

A sound-absorbent sack which zips around a percussive machine, reducing exhaust noise and clatter of piston on steel by over 50 per cent, is available from the Thor Power Tool Co. of America.

Pinazza self-contained flexible drive percussive rock drills are now available in this country. Power from a 5.5 h.p. petrol or 4.5 h.p. electric drive unit is conveyed via a flexible rotating cable to a mechanically-thrown hammer in the machine. Cuttings are removed by air flushing and the drill can be mounted on an air leg, compressed air for this purpose being available from a compressor made integral with the drive unit.

A differential drive electric rotary drill known as the PGAT 414 has recently been tested by the Mining Research Establishment at Isleworth. An ingenious combination of a powerful drive motor with a torque-sensitive feed motor affords to this equipment a flexibility in operation unusual in electrically driven machines. Thrust is limited to a controllable pre-selected maximum, which protects both the drill bit and the machine mounting.

The Joy CD 42 hydraulically-driven rotary drill is now available in this country. Both feed pressure and speed of rotation are infinitely variable throughout the working ranges.

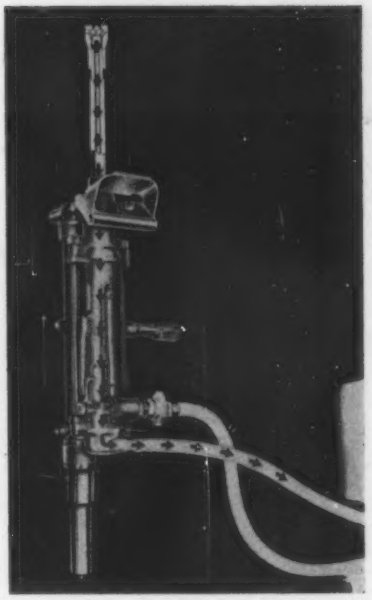
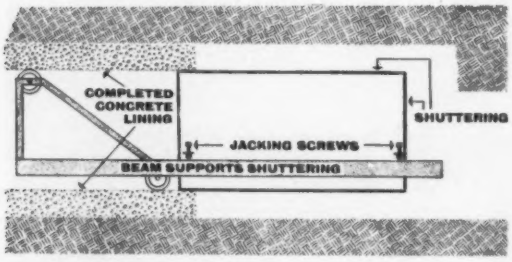


Fig. 1. The "Vacujet" dry autostoper with built-in suction device

By courtesy of Ingersoll-Rand

BLASTING DEVELOPMENTS

An intrinsically safe detonator-testing ohmmeter employing a photocell as its source of electrical power has been developed by Rhoanglo Mine Services Ltd., in N. Rhodesia. The dry cell power source of the familiar type of ohmmeter could possibly constitute a hazard in the event of grossly false functioning of the instrument due to damage, poor maintenance or tampering. Photocells, however, are self-limiting, and when of usual size are incapable of generating anything approaching a hazardous level of electrical power output even under short-circuit conditions and with brilliant illumination. The instrument described by W. G. Moffat in a recent paper to the Institution of Mining and Metallurgy had a minimum factor of safety of about 600, and represents a welcome improvement on the types which were previously available.



The shuttering in position for the pouring of the next section of concrete lining, the previous section having hardened

Fig. 2. New type of shuttering used by De Beers Consolidated Mines Ltd.

A struck steel wrench of novel design available from Atlas Copco Eastern, Inc., can be attached at any position along the steel irrespective of the presence of a collar.

The hard tipping of scroll-type rotary drill rods increases rod life and improves performance, due to the better removal of cuttings. The practice is growing.

Ingersoll-Rand have introduced a rock-bolting autostoper. Known as the "Vacujet," this machine has *built-in* jet suction and pressure discharge of cuttings. (*See Fig.* 1.)

The Gardner Denver model R68 autostoper is water controlled as a safety measure to prevent dry drilling.

Tamping Gun

At Castrop-Rauxel in Germany a portable tamping gun has been developed and during 1957 it was offered for sale after exhaustive underground trials. A mixture of stone dust and water is formed into a stiff paste having roughly twice the density of water. Under high pressure a 3 ft. long plug is extruded and pressed into each shothole. According to test results the stemming gun is suitable for use on holes inclined in any direction; as a result of the applied pressure some of the water in the plug drains away.

The gun is mounted on four solid rubber tyres, with additional steel rims to suit the rail gauge if used in drifts. Sufficient stemming material for 50 holes can be prepared in 5 minutes and the actual tamping time for this number of holes in a stone heading is of the order of 7 minutes. This compares with a tamping time of 70 minutes using the normal method of ramming plugs into shotholes with a rod.

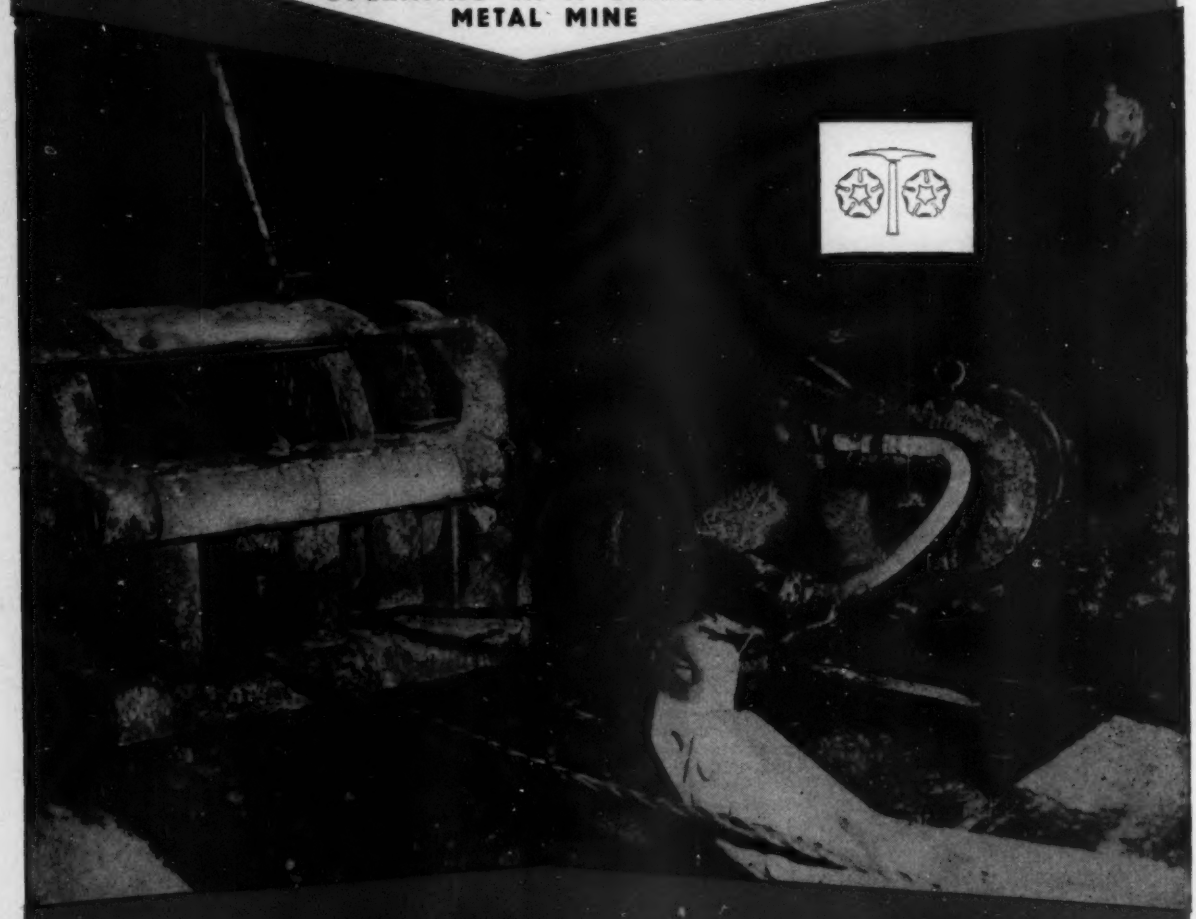
Although this machine is an obvious time saver, it is doubtful whether the efficacy of tamping can compare with sand or other granular stemming materials employed for this purpose.

SUPPORTS

In the South African mining fields collapsible chocks, as well as pneumatic and hydraulic props, are being used to an increasing extent. During the year consideration has been given to the feasibility of pneumatic stowing and a pneumatic stower was put on trial at Harmony Mine in the Free State. A mechanical stower has been developed, but the problem so far in applying it at the face is the transportation of dirt to the machine. This problem has been largely solved in many mines in other fields by a fairly widespread use of power stowing machines operating on high output faces. This makes it practicable to instal a comprehensive dirt transport system. Indications are that power stowing may be more generally introduced into South African mines.

PIKROSE

OPERATING IN A CANADIAN METAL MINE



WORLD WIDE
APPLICATION OF PIKROSE
SLUSHER HAULAGE

This on-site photograph from the heart of a Canadian Metal Mine shows two PIKROSE SLUSHER HAULAGES set together and working in opposite directions. It well demonstrates their rugged design and construction—hence their world-wide reputation for long life and reliability.

AUSTIN HOPKINSON & COMPANY LIMITED

DELTA WORKS · AUDENSHAW · LANCASHIRE

In Western Europe hydraulic supports are becoming very popular in metal mines and, indeed, yielding supports of all types are finding a wide application. In Continental collieries, yielding supports have been used on a large scale for many years, but it is a comparatively recent development for these support systems to be used extensively in non-coal mines.

A new type of shuttering enabling the concrete lining of tunnels to be carried out with greater speed and efficiency was used by De Beers Consolidated Mines Ltd., at Kimberley (*Fig.* 2). With block caving the lining of scraper tunnels is of prime importance, and at Kimberley this concrete lining is 2½-3½ ft. thick.

The new type of shuttering forms a complete oblong shell of fabricated steel, 6 ft. by 6 ft. in section and 12 ft. long, and is supported by two steel beams to which rubber-treaded wheels are fitted. These wheels, which bear against the floor and the roof of the completed part of the tunnel, hold the shuttering firmly in position during concreting operations and enable the entire apparatus to be moved forward comparatively easily after each pour of concrete has hardened.

The shuttering is freed from the surrounding concrete simply by loosening a panel in the top section and pulling the sides inward by means of screwjacks. The bottom is freed by raising the shuttering slightly on its supporting beams, also by the manipulation of screwjacks. No dismantling is needed and, once the operations described above have been carried out, the shuttering can be moved forward for casting the next shell with the minimum of labour. When it has been correctly positioned for the next pour the side frames are returned to "true," the loose roof panel is bolted on, and the masking which blocks off the concrete at the front of the shuttering is fixed in position.

Previously it was not possible to cast each section in one piece and so obtain a "monolithic" lining. The floor was poured first, after which the shuttering was collapsed from the completed section, moved forward to the newly-laid floor and re-erected for the moulding of the roof and the walls. With this method—apart from labour considerations—there was always the possibility of weakness in the bonding where floor and sides met.

The concrete lining process necessitates the "sliping" (cutting out to greater width and height) of the original tunnel as the work progresses. A tunnel developed at dimensions of 5 ft. wide by 7 ft. high is enlarged to 12 ft. by 12 ft. before the lining is added. With the old method, sliping had to be kept 30 ft. in advance of the completed concrete lining. This distance can now be reduced to 20 ft. with a corresponding reduction in the danger of falling ground. This danger is further minimized by a shortening of the time lag between sliping and pouring in the lining.

High Speed Development

Within the year several improvements on previous best performances have been claimed, though comparisons are somewhat difficult to make, especially if intended to indicate the general level of effort involved.

In the North of Scotland Hydro-Electric Board's expansion scheme an advance of 1,621 ft. in a 30-day period based on a 134-hour working week was achieved in the 8 ft. wide Lednock tunnel by R. J. McLeod (Contractors) Ltd. Drilling was done using five Atlas Copco BBD 41 WK machines and single length 7 ft. 10 in. integral steels. Compressed air at 95 lb./sq. in. at the face was delivered by two inbye Atlas Copco AR skid-mounted compressors. The cleaning procedure is noteworthy for conforming to convention in the use of an Eimco 21 rockershovel and California switches with a 100 ft. loop for car-switching. The labour force was comparatively-small, comprising only a foreman, two shift bosses and 30 men.

Another notable achievement was an advance of 484 ft. in six days in the 24 ft. diameter Eucumbene-Tumut tunnel in the Snowy Mountains, New South Wales. But for sheer high-powered rock-breaking, credit must go to those responsible for an output of 2,270 tons/day from a tunnel driven for the Swedish State Power Board. Perhaps mention of the size of this excavation should not be omitted—it was 52 ft. wide by 88 ft. high!

New Bunker Train Design

Most high-speed development schemes utilize rail haulage for muck disposal purposes, and under these circumstances the full capacity of the loader is seldom realized due to delays in car switching. There have been several solutions to this problem in recent years, with yet another appearing within the past year in the form of the Salzgitter BZ 35 bunker train (*see Fig.* 3). This consists of a number of open-ended wagons, coupled together by articulated joints and carrying a scraper chain in the bottom of the wagons throughout the length of the train. Muck can be accepted at a continuous rate of 107 cu. ft./min. up to a maximum load of 1,250 cu. ft. The loaded

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It is a pump of the centrifugal type, designed to be driven by an electric or pneumatic rotary drill unit. It provides the means for the effective control of 'nuisance water' in mine workings, on faces, or in roadways, wherever a power-driven rotary drill is available; and offers, in conjunction with selected forms of conventional equipment, the solution to the complete control of water, whatever the working conditions may be.

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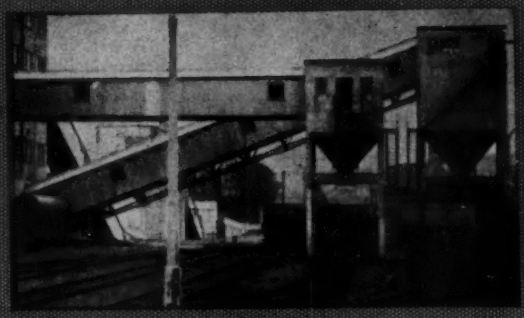

In addition to their well-known range of conveyors for use underground, Hugh Wood & Co. Ltd., supply conveyors designed to satisfy the special requirements of those who have conveying problems on the surface.

Surface installations often present difficulties considerably greater than those faced by the underground man. To the surmounting of such difficulties Hugh Wood & Co. Ltd., bring a unique knowledge and experience.

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train can negotiate bends down to 66 ft. radius, though loading and discharging has to be confined to straight track.

COAL FACE DEVELOPMENTS

Although published statistics have shown the tremendous advance of the Russian coal mining industry in the post-war years, it has not been until the last year or so that foreign mining engineers have been able to see for themselves just how these results have been achieved. Since the war the proportion of output mechanically loaded in seams less than 35 deg. inclination has risen from 0.1 per cent to approximately 40 per cent. There are now some 1,500 power loaders in use on the face, 3,400 loaders in use in hard headings and coal headings, and almost 200 tunnelling machines.

The total volume of development work in Soviet collieries is considerable, being on the average more than 80 ft. per 1,000 tons output: 17½ per cent of all underground workers are engaged on development. Although much has been done, a considerable increase in production is still to come. It is proposed that by 1961 some 7,000 miles of development will be accomplished every year.

Many types of machines have been developed for use in coal and hard rock headings. Most of these are awe-inspiring feats of engineering but have little application in anything other than coal. One heading machine, however, that is showing promise of a wider field of application is the PKG 2. This is shown in the illustration (*Fig.* 4) and as will be seen it consists of a large rotating head revolving at 6 rev/min. and providing the cutting action through the medium of a central cutter and two sets of picked discs. Each set of discs rotates on an axis at right angles to the line of the roadway and both turn with the head as it revolves. The cutting bits thus describe a hypocycloid in space, each bit periodically coming into contact with the face of the roadway, taking off a small strip as it engages the strata. The centre cutter, 25.6 in. in diameter, breaks up 12 per cent of the area of the face, cutting four concentric grooves (up to 1½ in. wide and up to 5 in. deep), and the strata left between the grooves are broken down by the wedge-shape flanges of the pick boxes. The two banks of discs, of 17.3 to 25.6 in. diameter, also cut concentric grooves (up to 1.34 in. wide and 2.95 to 4.72 in. deep) in the remainder of the face and break down the strata remaining between the grooves by the wedge-shaped pick boxes. The hard-metal tipped picks employed in the centre cutter and planetary cutters are removable.

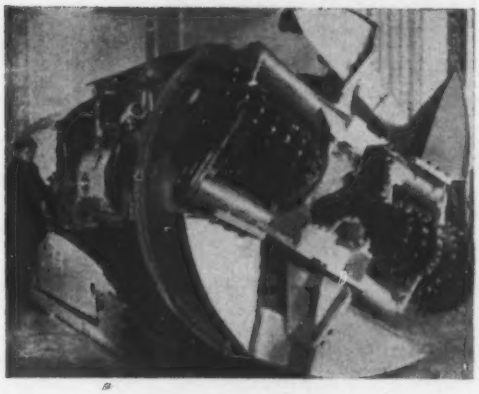


Fig. 4. PKG 2 Heading Machine

Two vertically-mounted picked drums located behind the main head cut away the sides of the roadway to provide support room. One of these drums can be seen on the left-hand side in the illustration.

The broken rock is gathered by four buckets, disposed around the periphery of the cutting head, and discharged into a hopper behind the head. This feeds on to a conveyer via a short intermediate belt. Caterpillar tracks—two on the floor and one on the roof—provide the means for advancing the machine, ensuring its stability and the thrust for operating in inclined roadways.

The PKG 2 was initially designed for operating in slightly-inclined seams 8.2 ft. thick, with a stable roof permitting an unsupported face area of about 151 sq. ft. In such conditions (where the coefficient of strata hardness does not exceed 0.8192 lb./sq. ft.), the power required by the motor seldom exceeds 40-50 kW.

The salient characteristics of the machine are as follows:—

Roadway diameter (excavated)	7.55 ft.
,, cross-sectional area	46.3 sq. ft.
Average specific pressure on ground tracks:	
Without thrust	11.4 lb./sq. in.
With thrust	15.6 lb./sq. in.
Length	20.7 ft.
Height and width of shield	7.55 ft.
Weight	15.3 tons
Length of conveyor unit	65.6 ft.
Weight of conveyor unit	1.34 tons

In Britain much work was carried out during the year on a prototype tunnelling machine for use in hard headings. As regards cutter loading machines for use on the coal face, the current world-wide trend is towards developing machines giving less fragmentation. More and more it is becoming evident that a machine's usefulness cannot be assessed by its potential output alone and size of product is a factor which is assuming greater significance.

No radically new face machinery was introduced during 1957 into the coal mines, but the period was marked by the appreciable strides taken in many countries towards full mechanization where practicable. This was particularly the case in Europe and to a lesser extent was evident in all the major coal producing centres. Although geological features militate against emulating the almost fully mechanized collieries of the U.S., machine power is continuing to supersede manpower wherever possible.

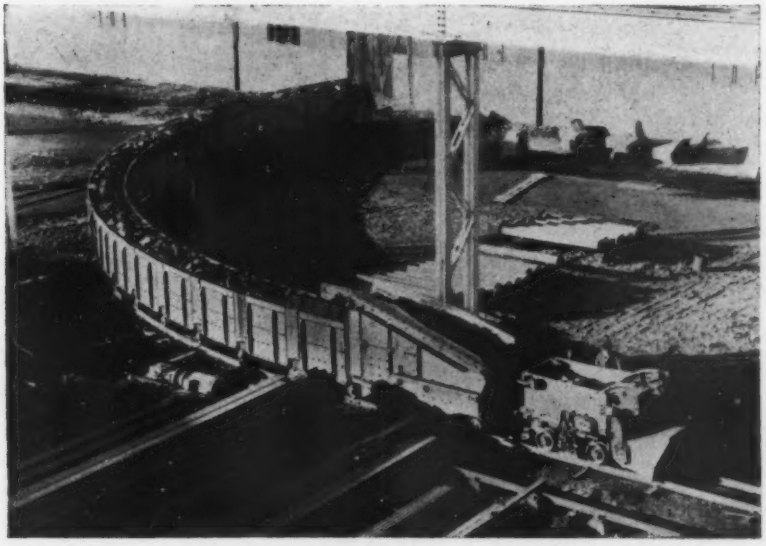
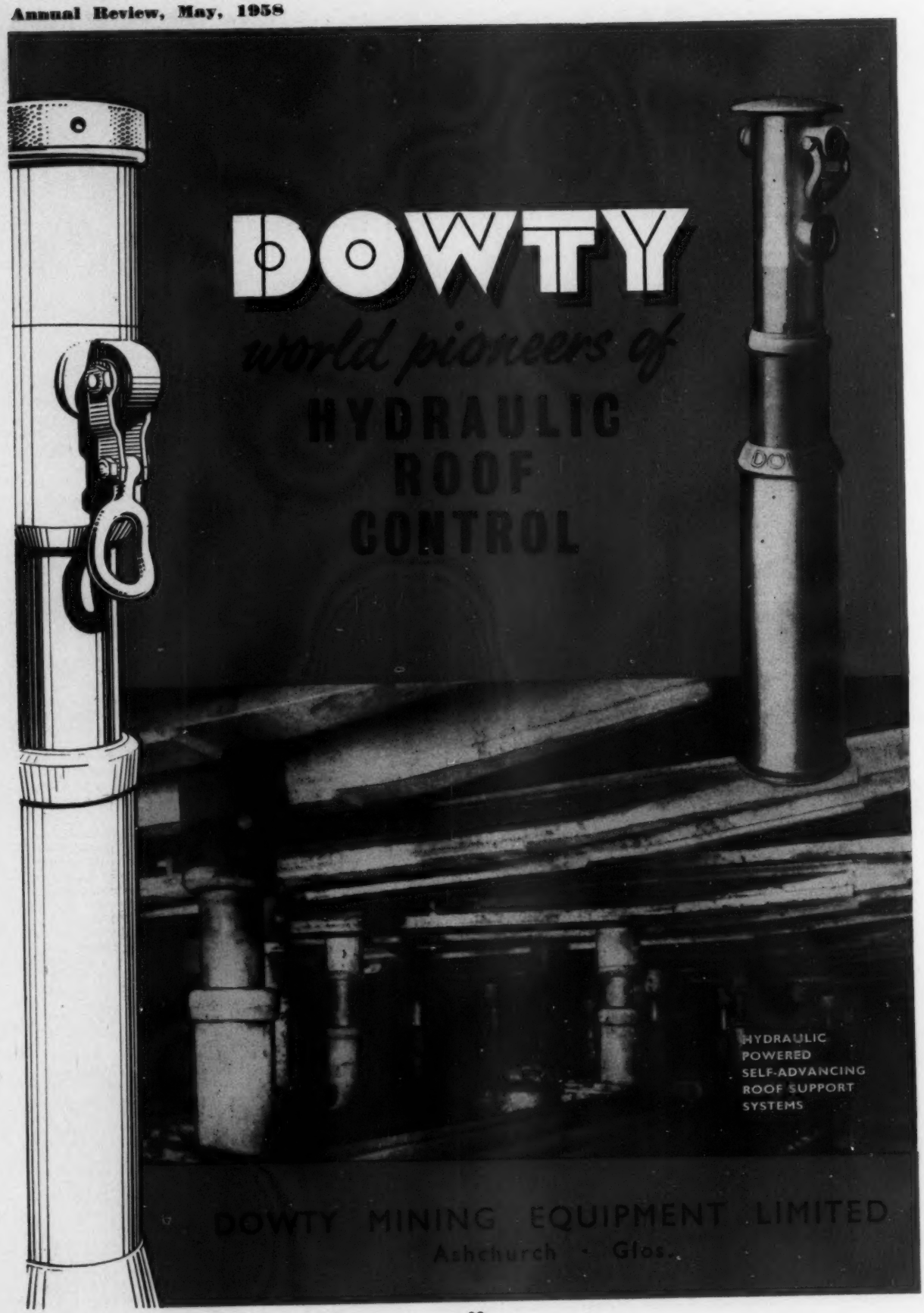


Fig. 3. Salzgitter BZ 35 bunker train

By courtesy of Salzgitter Maschinen AG

Hydraulic Transport

Successful application of hydraulic breaking, hoisting and transport in the mining of the solid hydrocarbon gilsonite in eastern Utah has stimulated interest in hydromechanization and captured the imagination of mining men in many parts of the world. Two wet methods of breaking the *in situ* mineral have been developed over the last four years by the American Gilsonite Co. The first of these utilizes a jet of water at 2,000 lb./sq. in. from a ¼ in. nozzle, and the second a heavily water-flushed TC-tipped rotary drill. After breaking, the mineral is washed by means of low pressure water down drifts sloping at 2½ deg. to a ¾ in. screen, oversize from which is hoisted in the usual manner while the −¾ in.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material and the water are pumped to the surface by means of centrifugal pumps. On surface the ore is finely ground and a 35 per cent gilsonite-water slurry is pumped 72 miles to a refinery, where it forms the raw material for a production of 1,300 barrels of high-octane petrol and 275 tons of metallurgical coke daily. The delivery pipeline rises 3,000 ft. to cross a mountain pass and then descends 2,500 ft. to the refinery.

A factor which played an important part in the decision to employ hydraulic transport in this case was evidently the dangerously explosive nature of gilsonite dust, but the method has proved so successful that a similar technique is now to be used for moving ground limestone a distance of 20 miles to a cement factory. In both these instances fine grinding of the raw material is necessary whether hydraulic handling methods are employed or not, although pneumatic transport of the finely-ground material would provide a possible alternative.

Experiments in the hydraulic hoisting of coal have been continued at Woodend Colliery, Scotland, and have proved to date the mechanical feasibility of the system. Economically, however, the position is somewhat obscure, and at present appears to rest largely with the practicability or otherwise of using a re-circulated coal-water slurry as the transporting fluid. Important advantages undoubtedly accrue from elimination of the dust and fire hazards created by the conventional methods of coal transport, and some financial gain must follow from relaxation of fire precautions in consequence. An exhaustive study of the various pipe-flow variables is under way, and developments are expected in the design of feed hoppers which do not give rise to large volumes of displaced water.

AMPHIBIOUS WAGONS

Although this article is primarily concerned with underground operations, an interesting development in the field of surface transport is worthy of mention in that this haulage system has been successfully used in certain mining areas. Recently, amphibious cargo carriers have been used to carry coal from the Ruhr to Salzgitter in Lower Saxony, and also to transport iron ore to the Hoesch Westphalia Steel Works. Essentially these amphibious carriers (*Fig.* 5) are containers holding upwards of 50 tons of ore and mounted on specially designed railway wagon frames. When transferring from rail to water or *vice versa*, the containers are manoeuvred into position by windlasses and hydraulic rams. It is claimed that the cost of this new method of transferring and transporting ore is less than 20 per cent of that of more usual means. The complete "amphibious harbour" built for the Hoesch Westphalia Steel Works was completed in four weeks this achievement being made possible by the use of prefabricated parts.

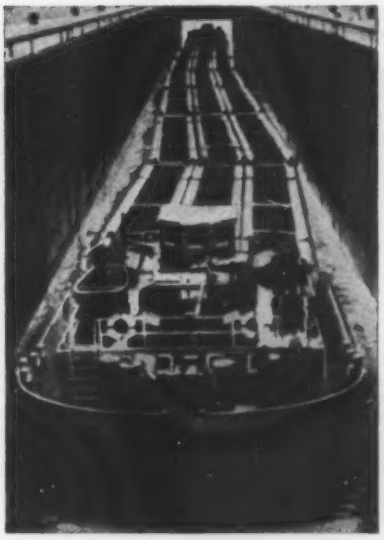

Fig. 5. Amphibious ore wagons

World's Deepest Mine

The East Rand Proprietary Mines Ltd. were first to reach a depth of 10,000 ft. below surface in November, 1955, and by May, 1957, had been extended to a depth of 10,391 ft. This was pointed out in letters to the editor of *The Mining Magazine* published in July, 1957, from which it was also learned that by the end of 1956 City Deep Ltd. was within 100 ft. of the 10,000 ft. mark, with Crown Mines Ltd. only 300 ft. short of it.

At Champion Reef the main auxiliary winze reached 10,000 ft. below datum (datum being 67 ft. above the shaft collar) in September, 1956, and future workings are planned to a depth of 11,500 ft.

From this it would appear that the Witwatersrand can claim the deepest mine in the world, but working conditions in the K.G.F. are somewhat more arduous. Rock temperatures in the bottom levels at Champion Reef are already in the region of 150 deg. F., and the ground is particularly prone to rockbursts.

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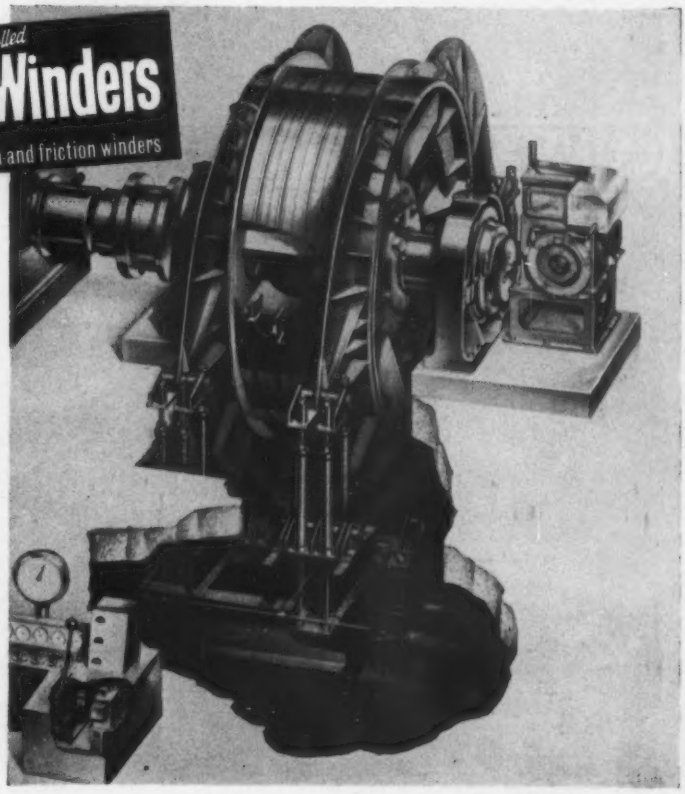

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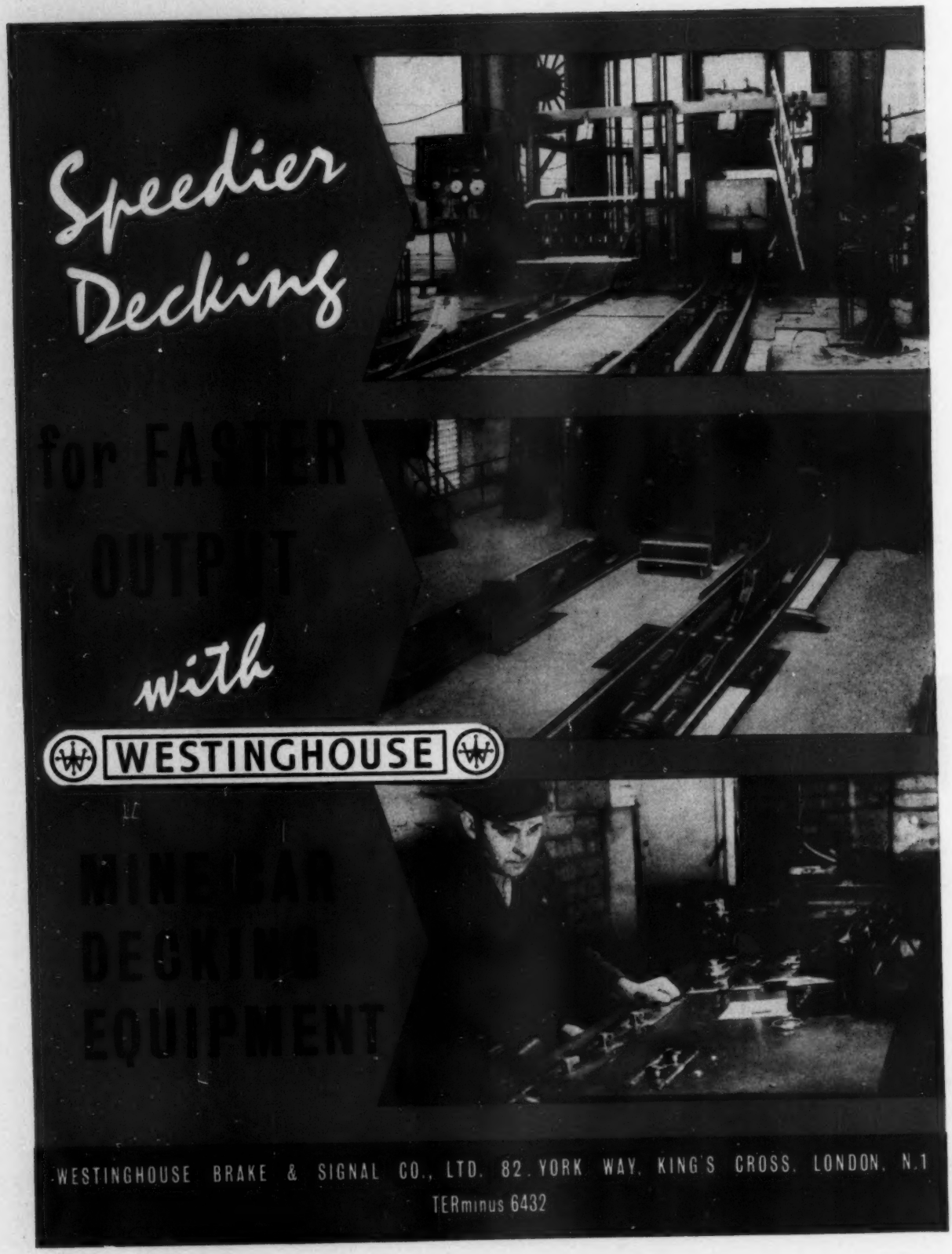
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Measurement of Rock Stress in Deep Mining

A revealing investigation of ground stress has been conducted in the K.G.F. with results likely to lead to improved control and greater safety. The postulate of inherent stress in the strong hornblende schist country rock of this mining field has been confirmed by the discovery of the existence of pressures much greater than could be accounted for simply by the weight of superincumbent rock. For example, in undisturbed ground at a depth of 3,646 ft., the measured vertical stress of 2.91 tons/sq. in. exceeded the possible static weight stress by 0.68 tons/sq. in. and the lateral measured stress of 3.35 tons/sq. in. showed far greater discrepancy.

Abutment loading has been investigated by locating a stress meter in a hole ahead of a stope face and taking readings as the face advanced towards it. This indicated a region of maximum stress some 6 ft. ahead of the face, which information has been turned to good account in developing the artificial de-stressing technique described later.

Photoelastic techniques applied to models have been used to determine such factors as the best location for a new shaft, the best method of extracting parallel reefs, and the effect of changing the rigidity of supports. It is unfortunate that these techniques as yet only permit examination of stress distribution in two dimensions, but nevertheless a sufficiently close analogy with the practical case can be drawn to render the results obtained from them extremely valuable.

Artificial De-Stressing as Rock Burst Preventative

Natural de-stressing of ground, usually in pillars or in abutment zones ahead of stope faces, was recognized by mining men long ago. More often than not the de-stressing process was gradual, manifesting itself by a general cracking and crushing process with some spalling away of loosened fragments around the periphery of a pillar or along a stope face. Occasionally it was violent, the sudden release of enormous strain energy giving rise to the unpleasant phenomenon now known as a rockburst. In all cases of natural de-stressing, however, the de-stressed ground was afterwards safe to work since it was no longer capable of storing energy—a most welcome circumstance. So it was that in 1953 on the Rand there evolved the idea of artificially de-stressing stope faces in an attempt to reduce the likelihood of dangerous rockbursts, or at least to cushion their effect if they did occur, by creating a band of fractured rock of adequate depth along the length of the stope face.

On the E.R.P.M. Ltd. and on the K.G.F. this has been attempted by drilling holes perpendicular to the stope face to a depth of 10 ft. and at intervals of 3 to 5 ft. These are then blasted. When the stope face has advanced 5 ft. more deep holes are drilled and the whole process is repeated. To date, results have been encouraging, since the de-stressing procedure adopted has resulted not only in fewer rockbursts but also in a lower percentage classed as severe. Improvements in procedure are, however, considered necessary and research is still continuing.

LOADING AND HAULAGE

In the large-scale underground working of thick, flat-lying deposits, there are signs of a trend away from crawler-mounted equipment towards rubber-tyred units with some equipment formerly diesel powered now driven electrically.

A survey recently undertaken by the Eagle Pitcher Co. of loading equipment used in their extensive Tri-State Mines covered crawler-mounted power shovels, slusher ramps, crawler-mounted overshot loaders, and rubber-tyred front end loaders, the last of these apparently giving the lowest cost per ton loaded.

The high mobility of rubber-tyred loaders was found useful in reducing shuttling time between muckpile and haulage unit and in moving between jobs without undue wear and tear. The rubber-tyred units investigated also showed greater dependability in point of freedom from serious breakdown; due to better provision for unit replacement, repairs could be undertaken at greater speed and rubber tyres afforded easier and more comfortable operation than with crawler-mounted equipment. On the other hand, careful training and close supervision of operators was found necessary if tyre costs were to be controlled, and high tyre costs were inevitable when the loaders were used on inclines (up or down) or in steep muckpiles.

Underground operation of 30-ton tractor-trailers is reported from the St. Patrick's mine, Avoca, Ireland, where four Caterpillar DW 21-Athey PR 21 combinations are at work hauling earth and rock through a 17 ft. high by 16 ft. wide tunnel to surface. A feature of new equipment of this class is the use of high strength steels in the body structure, which enables a high load/dead weight ratio of the order of 4 to 1 to be achieved.

The Chaseside 8½-ton Oremover illustrated in *Fig.* 6 is designed for underground operation and embodies several other attractive features. One interesting innovation is the optional fitting of an overhead scraper unit to assist loading by scraping material to the back of the hopper when small overhead loaders are used. The drive unit and the hopper are each independently mounted on one axle, which enables all four wheels to maintain contact with the ground at all times when travelling over rough ground. The driver's seat is swivel-mounted and the controls are duplicated so that the vehicle can be driven conveniently in either direction; by this means working in confined space has been very greatly facilitated.

Conveyor Belt Haulage

More and more are mine operators becoming aware of the fact that haulage can be the weak link in the chain of operations stretching from the face to the surface. That inadequate haulage has been the brake on increased production has been illustrated too often in the past, but current developments suggest that these illustrations will stay in the past.

Belt conveyors are being increasingly used as the main haulage medium. One of the pre-requisites of an efficient conveying system is an efficacious belt tensioning arrangement. Most heavy duty conveyors are tensioned either by a dead-weight drum or a winch take-up.

A new tensioning device has recently been introduced by Richard Sutcliffe Ltd. incorporating the advantages of both systems. Essentially the tensioning arrangement involves the replacement of the hand-wheel of a normal winch take-up gear by a reversible hydraulic motor (*Fig.* 7). This motor is controlled by a closed circuit feed-back system based on a belt-tension measuring unit. The powered tensioning winch is thus automatically brought into action whenever there is any change in the predetermined belt tension. Thus the hydraulic motor controls the winch, enabling it to compensate immediately for any change in tension occasioned by change in load on the belt or change in conditions at the driving head. In this respect the device is similar in action to a dead-weight gravity take-up. However, the hydraulic circuit is designed to lock when the conveyor stops. Thus on re-starting the conveyor there is none of the violent belt movement associated with gravity take-ups. This can give rise to belt slip, particularly when the load on the belt is heavy.

The diagram illustrates the arrangement of the unit. The loop carriage A of a standard loop take-up is coupled by a wire rope and three pulleys, B, C, D, to a winch drum E, powered by a reversible hydraulic motor F driving through a worm reduction. The motor is controlled by a three-way valve H which receives oil from a reversible

Fig. 6. Chaseside "Oremover," fitted with overhead scraper for use underground in conjunction with small overshot loaders

By courtesy of Chaseside Engineering Co.

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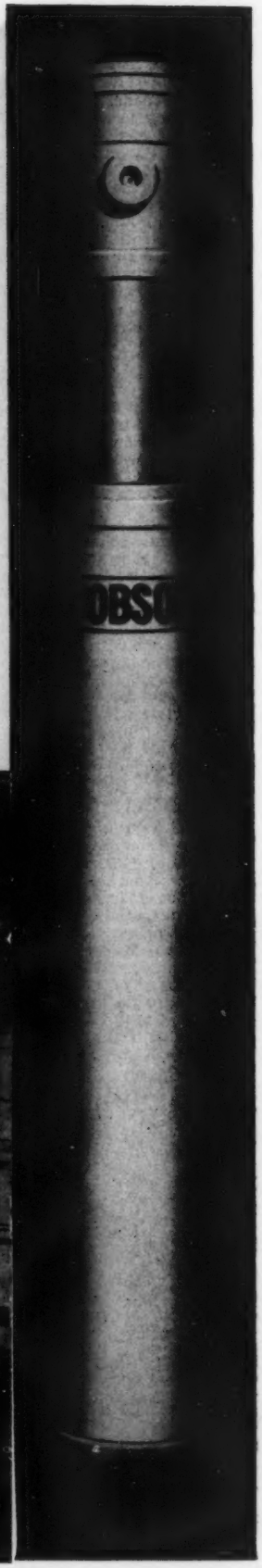

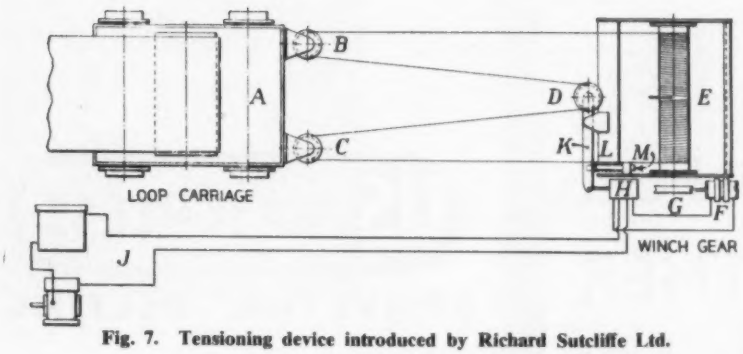

Fig. 7. Tensioning device introduced by Richard Sutcliffe Ltd.

pump and tank J mounted at either the drive head or some other convenient point. The pump can be driven either by the main conveyor motor or by a small motor, sequence-controlled from the main supply, and no matter in which direction it is driven, the oil flow will always be in the same direction. Pulley D is mounted on a hinged arm K which bears against a compression spring L whose restoring force can be varied by a screw M. Arm K terminates in a connection to the spool of the valve H, stops being provided to limit the angular movement of K to that required by the operation of the valve.

When the belt tension is at the required value, the arm is central, with the force exerted by the belt on pulley D in equilibrium with the restoring force of the spring. The valve spool is also central, the oil from the pump being by-passed to the tank. Consequently, the hydraulic motor and winch are "dead." If there is a decrease in the return-strand belt tension, caused by a temporary increase in belt stretch associated with an increase in conveyor load, the spring force being greater than the pulley reaction will turn the arm in a clockwise direction, thereby winding rope on to the winch drum. The loop carriage is thus moved to the right, absorbing the slack belt, and gradually building up the tension again. When this reaches a value slightly greater than that required for equilibrium the spring is compressed and the arm turns anti-clockwise, i.e., back to its original position. The oil is thus by-passed back to the tank, whereupon the hydraulic motor and winch again become "dead."

Obviously, increase in belt tension has the opposite effect: the arm turns anti-clockwise to throw the valve spool to the reverse position and the winch is driven in the direction to pay out rope until equilibrium is restored.

The spring is adjustable so that the restoring force can be varied and hence different belt tensions can be achieved, the chosen value depending on the conveyor horsepower, angle of wrap, position of unit on the conveyor profile, etc. A manually-operated valve is also fitted to isolate the hydraulic motor from the supply to enable the loop winch to be operated by hand. This allows the loop carriage to be adjusted should occasion arise, e.g., when additional belt is fitted to the conveyor.

From what has already been stated it will be clear that the unit is a compact equivalent of a dead-weight tension gear in which a spring takes the place of the weights, and changes in weight are obtained by a simple adjustment in spring tension. Being based on a standard loop take-up, it follows that the unit can be fitted to any existing loop; that by means of the valve between the hydraulic motor and the supply it is possible to convert the unit quickly to manual operation; and that it can be installed anywhere along the run of a conveyor.

Tests carried out with the tensioning device installed on a high duty underground belt conveyor have indicated that the apparatus is able to detect and act upon changes in tension of as little as 10 lb. Bearing in mind that incorrect application and maintenance of slack side tension is responsible for many of the operating troubles of belt conveyors, it will be apparent that here is a device which is of great importance to conveyor users.

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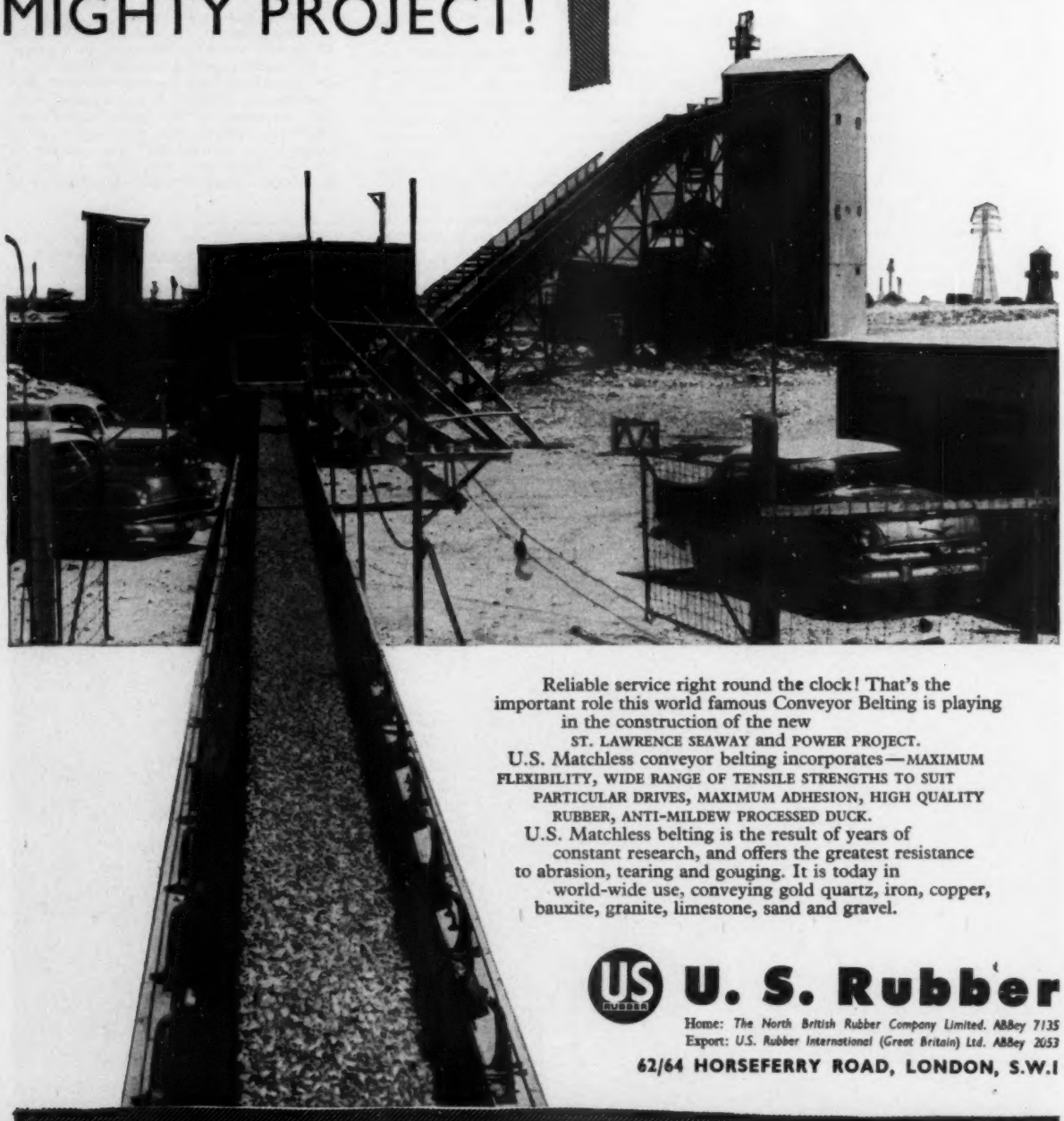

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Fig. 8. Conveyor right angling pulleys

Another useful innovation is the introduction in the U.S. of a right-angled turning device for use on belt conveyors serving continuous mining machines. In many installations output from power loading machines has been limited by the inability of the "follow-up" transport system. In the 1957 *Mining Journal Annual Review* mention was made of a mobile extensible conveyor for use with high capacity loading machines. This idea has been improved upon by the introduction of a device which enables a rubber belt conveyor to load around a right-angled bend. Belts had been designed previously making it possible to achieve this 90 deg. turn, but many of these systems were impracticable and a definite need existed for a compact belt turning device. This need has been met by the Coal Division of the Jones and Laughlin Steel Corporation of America. Underground trials with the prototype have given encouraging results and the system is regarded as being very promising.

Essentially the turning device consists of two sets of roller pulleys mounted in a rigid framework at right angles. These roller pulleys serve to guide both strands of the conveyor belt on to the angling pulleys. (*See Fig.* 8). These pulleys are studded radially along their length with small low friction bearings. As each angling pulley revolves about its longitudinal axis these small bearings roll freely in a direction parallel to this axis, so removing the tendency of the belt to creep along the angling pulley when in contact with it, due to the virtually frictionless contact between the pulley and the belt.

With correct angling of the studded pulley and correct positioning of the roller pulleys it is claimed that the belt load can be turned easily through 90 deg. with no more spillage than occurs with a normal tripper. Naturally the use of a series of small diameter pulleys increases belt wear and belt tension and greater horsepower is required at the conveyor drive head. So far the unit has been used only on mobile extensible belts with a view to increasing the range of application of this type of gathering conveyor, but such a belt turning appears to offer other possibilities.

Welded Rail Joints

In the realm of heavy (100 h.p.) trolley-wire haulage, the successful use of welded rail joints in the mines of the Tennessee Coal and Iron Division is worthy of note. Main haulage track in these mines consists of 90 lb. rails on treated wooden ties laid on gradients not exceeding ± 6 per cent, substantially ballasted and using welded rail joints. New track is fishplated; then, after it has settled in, a welding crew removes the fishplates and welds the joints. Welded joints eliminate electrical bonding and give reduced electrical resistance resulting in considerable savings in power and maximum safe hauling speed is increased.

In these mines locos are fitted with a radio telephone which uses the trolley wire as a signal carrier to provide communication with loading and discharging points. Automatic block signalling is provided and spring split switches or automatic electrically-operated switches are used at laybys.

Resulting from the introduction of these and other efficiency-promoting factors over a seven-year period, haulage accidents have been reduced by 66 per cent and haulage capacity has increased 59 per cent.

Shuttle Dumpers

A mechanized mine car has been introduced in Sweden by Atlas Copco to enable operation of a shuttle car service over ordinary mine rail track. The shuttle dumper takes the form of a 2.62 cu. yd. rail truck fitted with a 3 h.p. air motor supplied via a hose reel from the mine compressed air service. When connected to the supply by means of a swivel connection at mid-run the unit has an operating range of about 600 ft. with a maximum speed of 330 ft./min. A novel feature is provision for synchronization of the dumper motor with the loader crown motor during loading.

Mine Car Vibrators

The clean discharge of wet, frozen or sticky ore from mine cars is often difficult to achieve, and the abusive practices to which recourse has often to be taken in order to retain full car capacity are both damaging to the cars and expensive in labour. Simple cleaning procedures employing compressed air lances or corrugated tipping ramps are sometimes effective, but in obstinate cases use could well be made of a vibrator of the type now available from the Cleveland Vibrator Co., Ohio. For underground use a portable vibrator unit is used in conjunction with a female socket attached to the side of each car body. The vibrator unit is mated with the socket during tipping, after which it is transferred to the next car. Other units are designed for fitting to the frame of a rotary tippler and provision can be made for automatic operation when a contained car is inverted.

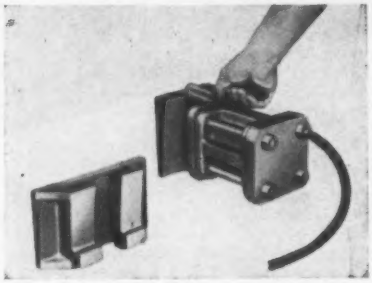


Fig. 10. Compressed air mine car vibrator

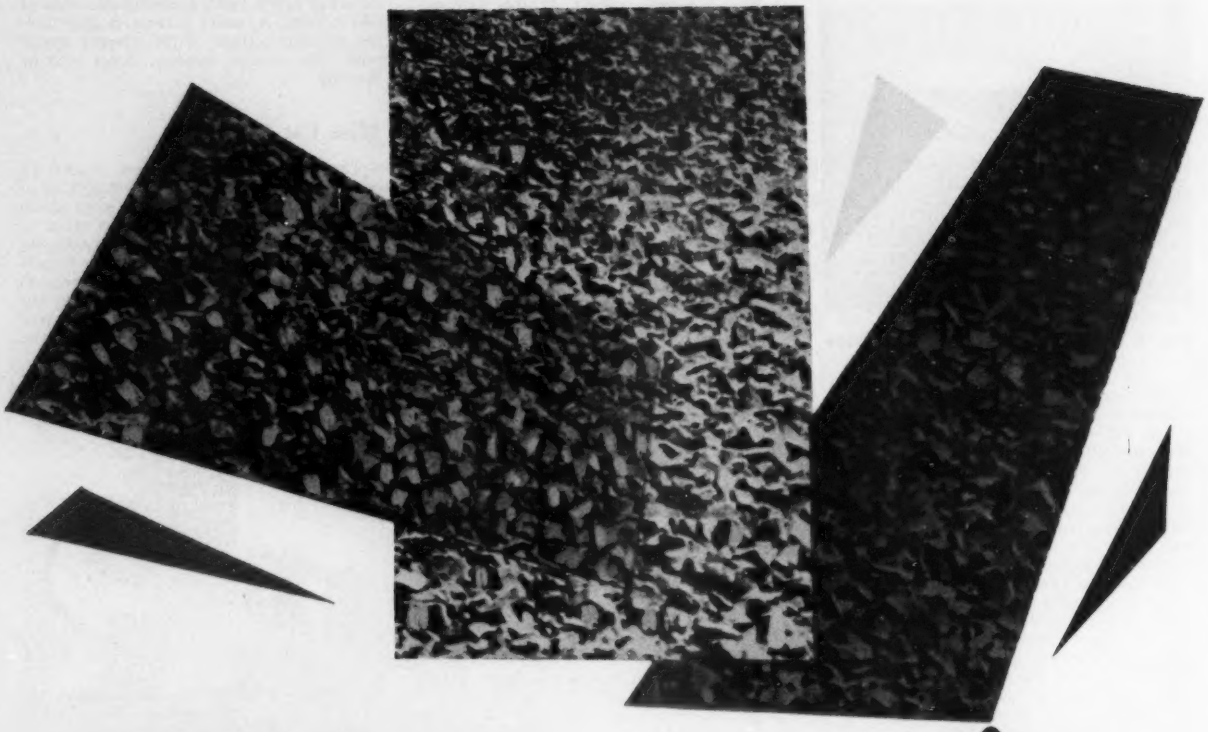
By courtesy of the Cleveland Vibrator Co.

MINE DRAINAGE

During the year Sumo Pumps announced in America and Britain an extension to their range of submersible pumps. This is claimed to function effectively in heavy duty pump-

Fig. 9. Atlas Copco shuttle dumper

By courtesy of the manufacturers



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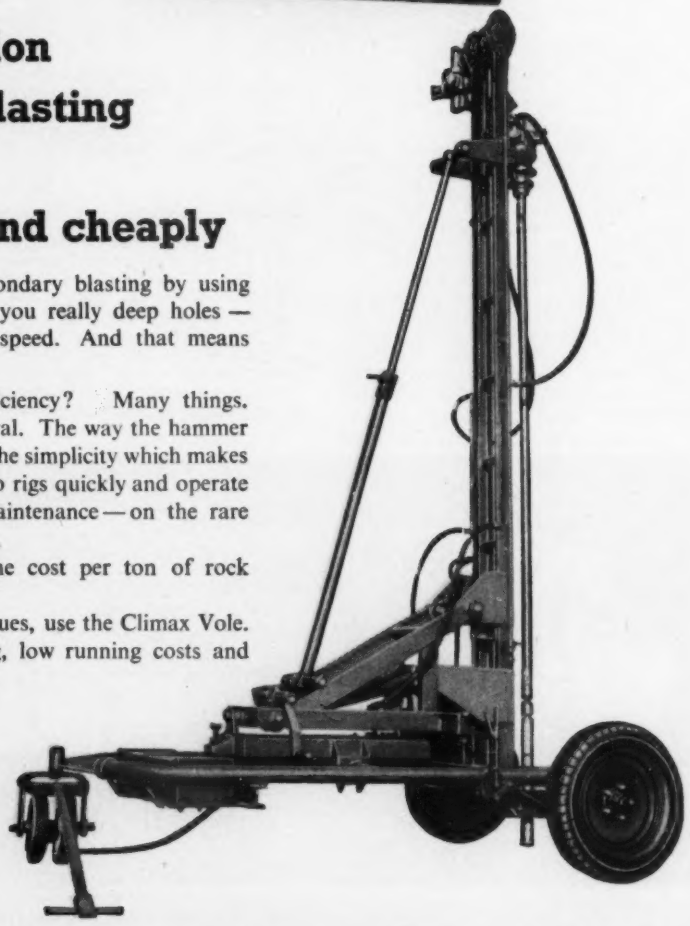

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ing of water containing up to 20 per cent solids within the size range 0-¾ in. (*Fig.* 11).

The pump is adaptable to filter screen sump service, de-watering mines and removing muck from excavations. The unit operates either partly or fully submerged and features a built-in thermostatic cut-off to protect the 7½ h.p. motor against damage from overloading, overheating or obstructions. Designed for handling by unskilled labour, this pump embodies a particularly robust construction which will be appreciated by users in the mining industry. Two or four-bladed bronze impellers are incorporated and the pump has a useful characteristic. With the four-bladed impeller the stated duty ranges from 6,000 g.p.h. at 60 ft. head to 15,000 g.p.h. at 30 ft. head.

The motor operates in a sealed oil bath and is cooled by the discharge water. The entire unit weighs just over 2 cwt. Recent experience in the field with this pump has been very satisfactory and it is understood that the range is to be increased by the development of a larger model of 25 h.p. and also a smaller unit.

In some Continental mines underground drainage ditches are being lined with polyvinylchloride belting in an endeavour to prevent seepage through the floor and sides of the ditch. The belting is acid resistant and is reinforced with lateral thin steel strips which serve the purpose of constraining the belting to any particular contour. Joints are made either by bonding or by P.V.C. nuts and bolts. Being flexible, the ditch lining is easily transported underground. Although the initial cost is high, it is considered that the P.V.C. belt will have a useful life of several years.

Ventilation

The International Nickel Co. of Canada has over the past five years installed six large vertical fans, and according to the Inco ventilation engineer such fans are definitely superior to horizontal units. Five of these fans are of similar type and have the fan impeller mounted directly on the motor shaft extension. Since they have adjustable pitch blades, it is possible to use direct drive with constant speed motor—a very desirable feature. All these vertically mounted fans have given very satisfactory service.

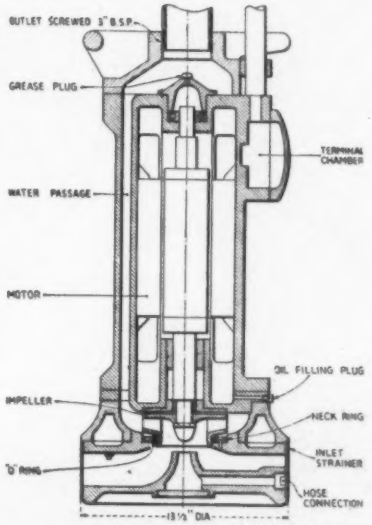

Fig. 11. Sumo Submersible Pump

The first vertical mine fan installed was a 124 in. exhausting unit at Creighton in 1952. Others were subsequently put into operation over the next five years, in each case being mounted on the concrete collar of the air shaft. With the exception of a 198 in. fan at Frood Stobie, the motor is supported in the inner hub streamlining and the load is carried either by the fixed vanes or streamlined struts attached to the outer casing.

Inco turned to vertical fans on the grounds that total costs for the installation are lower, the increased fan cost being more than offset by reduced installation cost. Furthermore, air flow shock losses are eliminated with the removal of the need for fan drifts. The fact that a vertical fan does not need a fan drift is in itself an appreciable factor in favour of the adoption of this system. It is considered that the amount of machine maintenance is less due in part to simplified bearing load and also that any repairs that may prove necessary can be more easily effected. However, as with any direct drive inspection of motor bearings, etc., is not an easy matter.

These six vertical fans are currently handling a total volume of 1,400,000 c.f.m.—approximately half the volume of air required for the five Inco mines.

Auxiliary Ventilation

Statutory standards of underground ventilation vary widely and adequate supplies of fresh cold air cannot always be taken to the working face by means of the

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main mine fan. Auxiliary ventilation has come to be recognized virtually as a *sine qua non* of good mining practice. In this connection flexible plastic ducting reinforced with spiralled steel bands is finding widespread approval.

In Germany a simple device has been evolved, aimed at giving close and positive control of air-flow from auxiliary fans. This is the pressure-tube air control apparatus as illustrated. (*Fig.* 12). It is an extremely simple controller and having no parts subject to wear requires the minimum of maintenance. In operation a facing tube (1) is placed in the main stream and the pressure within the duct is communicated to the soft rubber bag (2). If the pressure within the duct falls, the dead-weight (3), in the absence of balancing air pressure, causes the rubber bag to stretch. This causes the walls of the bag to come together and the switch plates (4) come into contact. This operates a relay which has the effect of automatically switching off electrical machinery in-bye of the fan discharge point. At the same time, visual and audible alarm signals are caused to come into operation.

Being placed outside the ventilation duct, the control apparatus is easily inspected by the mine official, who can also give the alarm signal by simply compressing the rubber bag by hand.

Switches having a similar *modis operandi* have also been fitted in surface fan houses. When the air-flow falls below a predetermined minimum, visual and audible alarms are set off. The use of this control system makes the continuous supervision of the ventilators unnecessary.

HOISTING

Closed circuit television has been installed at Peabody No. 17 Mine, Illinois, enabling the hoist operator to observe the skip as it discharges. He is thus able to spot any wedging of mineral in the skip, so preventing spillage on subsequent runs due to overloading. The hoist operator can also check that the skip doors are properly closed and he can regulate the rate of feed into the storage bin on the surface. Prior to the installation of the TV circuit these were jobs necessitating the employment of additional pernsonel.

At this mine two separate TV systems are installed—one serving as a stand-by. Each camera is housed in a 12 in. x 12 in. x 32 in. dustproof cabinet and produces an 8 in. x 10 in. picture. Floodlights are provided for night shift working. Maintenance is simplified by the division of the system into small, easily accessible units and test points are provided on all units to facilitate fault finding and adjustments.

Whilst it is not expected that TV control will have a wide application in mining generally, the resultant financial benefits in a high-wage industry must make this labour-saving gadget an attractive proposition.

Work is well under way on what is claimed to be the first fully automatic winder using the G.E.C. patented system of control. (*Fig.* 13). This plant is being installed at Cwm Colliery in South Wales and when reconstruction is completed in four years' time this will be the biggest mine in Wales. Designed to raise 500 tons per hour from 2,300 ft., the winding engine is driven by an 11,000 volt slip motor. Two 12 tons capacity bottom discharge skips will be used in balance and 42 winds per hour are projected.

Three methods of hoist control are available, namely:—

(1) Cyclic automatic winding in which the complete installation operates without human aid and winding continues automatically so long as mineral is available at the shaft bottom and storage is available at the surface.

(2) Push-button control by which winding is under the control of the surface and underground shaft attendants.

(3) Manual control by the hoist operator, used when winding men or inspecting equipment.

The protection of the winder follows standard practice, but in addition includes certain features desirable when using automatic control. In the event of a relay failure

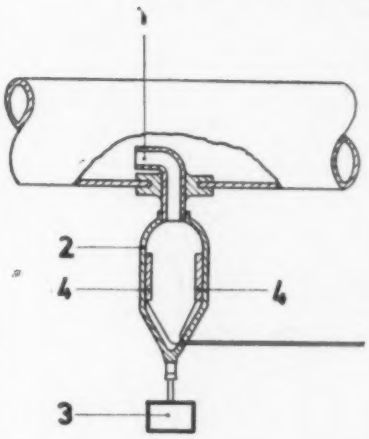


Fig. 12. Air control apparatus

or a circuit fault when the hoist is operating on automatic or push-button control the plant is shut down, and if the skips are mid-shaft the hoist can only be re-started on manual control.

Multi-Rope Drum Winder

Multi-rope hoisting with drum winders forms the basis of new equipment invented and designed by R. Blair, consulting mechanical engineer to the Anglo American Corporation of South Africa.

The important advantages which result from replacement by several thin ropes of a single thick winding rope include such factors as the reduction in size of the winding drum or sheave required, improved sense of security, lower rope costs, and higher drum speeds requiring lower gear ratios between electrical drives and drums.

Friction (Koepe) winding with multiple ropes is well-established, but this system is such that no provision for rope storage has to be made. With drum winders hoisting from deep shafts, however, the rope is commonly stored in layers on the drum, and when more than one rope is independently attached to each cage or skip, the difficulties arising from unequal coiling of the several ropes have hitherto been considered so great as to render the method impracticable. With the newly-developed system this problem is overcome by making provision, in the event of unequal coiling, for the hoist to trip automatically and maintain equal tension on the ropes while stopping.

Large savings in the cost of the winder drums and mountings are achieved using a multi-rope rather than a single rope system. Not only are the drum dimensions greatly reduced, but less bending strain is imposed on the drum shaft on account of the distributed nature of the load.

A twin-rope drum winder has been recently subjected to exhaustive tests which would appear to indicate that the new system is entirely practical and measures up to expectations.

Should the use of multiple ropes lead to some revision of the safety factor requirements, an immediate increase in the maximum feasible depth of a single stage wind would result and a reduction in cost of mining operations at great depth would follow, this being perhaps the most important consideration of all.

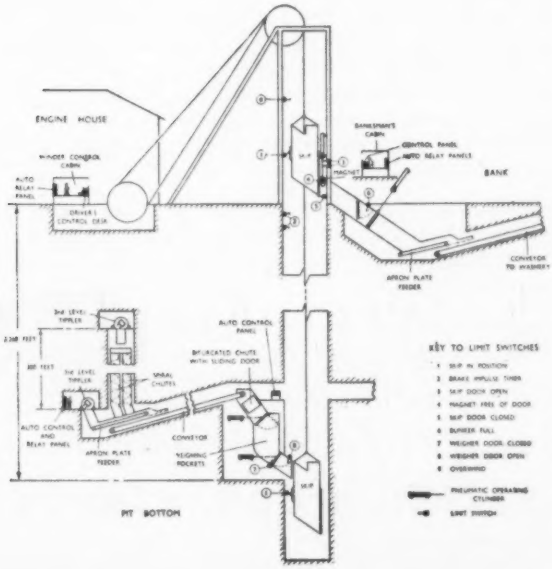
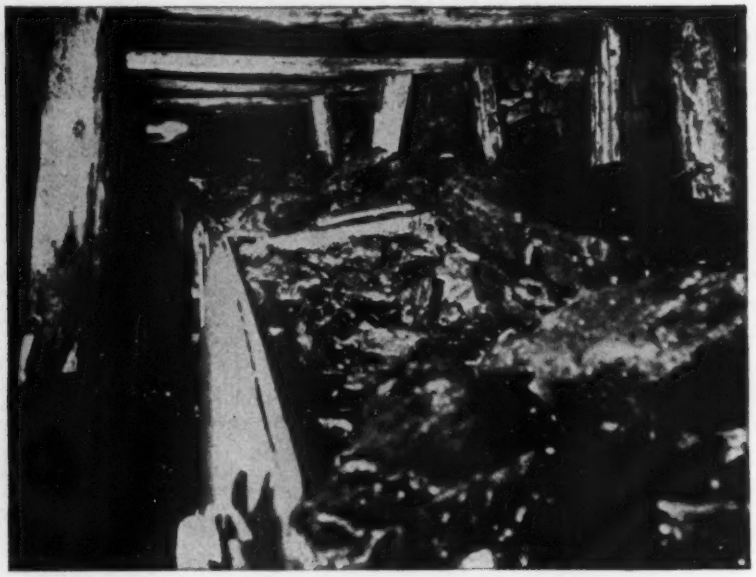


Fig. 13. Fully automatic winder using G.E.C. patented system of control



Safety FIRST

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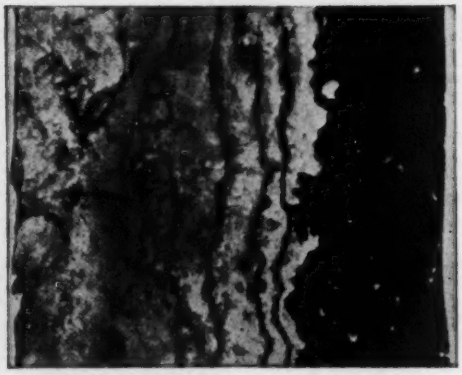
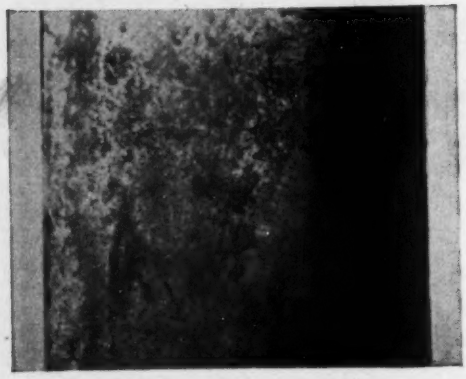


Above : 5-ply rubber. Below : 5-ply PVC belting. Both after 700 hours abrasive testing



CONVEYOR BELTING MADE WITH GEON PVC

First and last in research, British Geon has taken a pioneering role in the development of polyvinyl chloride plastics for use in fire resistant conveyor belting.
In addition to its widely recognized properties as a fire resistant material, Geon PVC is superior under all conditions of service.

ABRASION RESISTANCE

Tests made on five-ply rubber and five-ply PVC belting have demonstrated the superior abrasion resistance of Geon PVC. Whereas the rubber covers were stripped in twelve hours, the covers made with PVC were not appreciably worn in 100 hours. On continuing the test to 700 hours, the rubber belt was entirely worn away in places while with the PVC belting only the first ply was affected.

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Belting made with Geon PVC, being chemically inert, is completely resistant to the action of oil and grease.

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Conductor-Cored Hoisting Ropes

Hoisting ropes with cores containing insulated copper wire conductors are now available from several American manufacturers. The use of plastic insulation together with spiral winding of the conductors is expected to result in a conductor life commensurate with that of the rope itself, and should this expectation be fulfilled conductor-cored ropes are likely to find wide application.

Communication between a travelling cage and the hoist operator has been provided for several years at a number of mines by means of V.H.F. radio using the hoist rope as a conductor between two transmitter-receiver installations, one carried in the cage and the other in the head frame. This system works well, but in common with other portable electronic equipment is prone to failure and requires continual changing of batteries.

Successful use of a 3-conductor rope over a period of at least six months is reported from the American Smelting and Refining Co.'s Galena Mine. Here, in addition to conveying signals from the cage, use of the conductors is made to indicate slack rope as well as the position of the bottom-dump skip door after dumping.

SHAFT SINKING

It is becoming customary year by year to expect new shaft sinking records from South Africa, and in this the past year has been no exception. The record footage of 834 ft. sunk and 810 ft. concrete lined in 30 days was achieved during the first full month of regular sinking at F. S. Saaiplaas No. 2 Shaft. The excavation for this shaft was 30 ft. in diameter and it was carried down through the Karroo shales into the underlying lavas.

Mucking in this shaft was done by means of a 20 cu. ft. cactus grab capable of loading at up to 300 tons per hour working in conjunction with 9½ ton kibbles.

A further significant feature was the use of a pre-cementation technique which not only led to a virtually dry shaft but largely eliminated lost time due to cementation during sinking. Before sinking began three boreholes were sunk to a depth of 2,240 ft. at a distance of 30 ft. from the proposed perimeter and into these was injected a total of 6,755 pockets (96 lb. bags) of quick-drying cement. A number of cement filled fissures were intercepted during sinking—but no water.

In America, in sinking a 9 ft. x 18 ft. incline, a gathering-arm loader has been used in conjunction with an extensible belt conveyor to achieve an advance of 4 ft. to 10 ft. per shift for a four-man crew.

Shaft mucking using overshot loaders and tractor shovels, air or electrically operated, would appear to be increasing in large-sized shafts.

Also in America, in the sinking of shallow vertical shafts through soft ground, the practice grows of drilling to outline the shaft periphery in order to reduce shock to the walls when the remaining core is blasted subsequently. Mucking with clam-shells is usual in this work.

In sinking by the freezing method through unconsolidated water-bearing ground, expansion of the ground sometimes stretches and fractures the borehole casing pipes. P.V.C. pipes used for the casing and polythene for the inner down pipes are capable of stretching without fracture, and by virtue of their resistance to corrosion leakage of the coolant is also obviated.

Sinking Small Shafts

The sinking of main shafts has now reached a state of almost perfection but, quite apart from major shaft sinking jobs, a definite need exists for the development of equipment and technique for sinking small diameter shafts. In this connection the use of Calyx drilling bits is receiving renewed attention and there has been a marked increase in the use of this type of core drill of recent years. The popularity of the Calyx drilling method has waxed and waned many times since Davis introduced the use of chilled steel shot at the turn of the century. It is no doubt true that the field of the Calyx drill is in boring core holes of sizes larger than those made by diamond drills, drills, but recent experience has indicated that Calyx drilling can be used at depths formerly considered impracticable and at costs which are below those of standard mining methods employed in the sinking of small shafts.

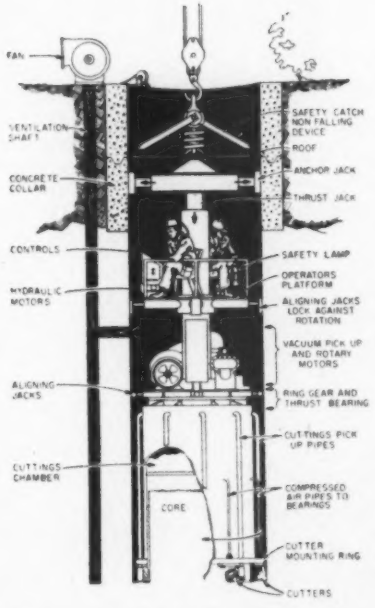


Fig. 14. The Zeni core drilling machine

At Olga No. 1 and No. 2 mines in Virginia two interesting Calyx drillings have recently concluded—the former a 36 in. diameter hole down to 733 ft., and the latter a 48 in. hole down to 976 ft. This latter shaft is an upcast carrying 45,000 cu. ft. per minute. Initially, a 60 in. diameter Calyx was used down to 40 ft. and a 54 in. casing was concreted in to seal off any surface water not already shut off by preliminary grouting. The time taken for the entire shaft sinking, including grouting, was 6½ months at a cost of $127 per ft.

Ventilation of the shaft during drilling is achieved by utilizing an exhaust fan on the surface which draws air through a borehole—a re-drilled grout hole—connecting at intervals with the main shaft chamber.

Normally six cutting bits are used, although there is provision to mount 12 on the cutting edge. Speed range is between 0.9 and 15 r.p.m. with a maximum thrust of 100,000 lb. Cutter life averages about 52 ft. per set of rollers in the type of strata so far drilled through; viz., sedimentary shales, limestones and sandstones. After about 5 ft. advance the entire drilling machine is withdrawn and the core catcher inserted. Normally a small charge of explosive is used to facilitate breaking off of the core—this is placed in a jackhammer hole drilled centrally through the core. Penetration rate in the type of strata drilled through has averaged 3 ft. per hour when drilling. Obviously the overall speed of sinking depends on many factors, but progress in Virginia suggests a sinking rate of approximately 8 ft. per shift with a 75 in. diameter shaft. Only in unstable or water-bearing strata is it considered necessary to line the finished shaft. Smoothness of shaft wall is assured by the cutting action of the drill and also by the non-use of explosives in the sinking operation.

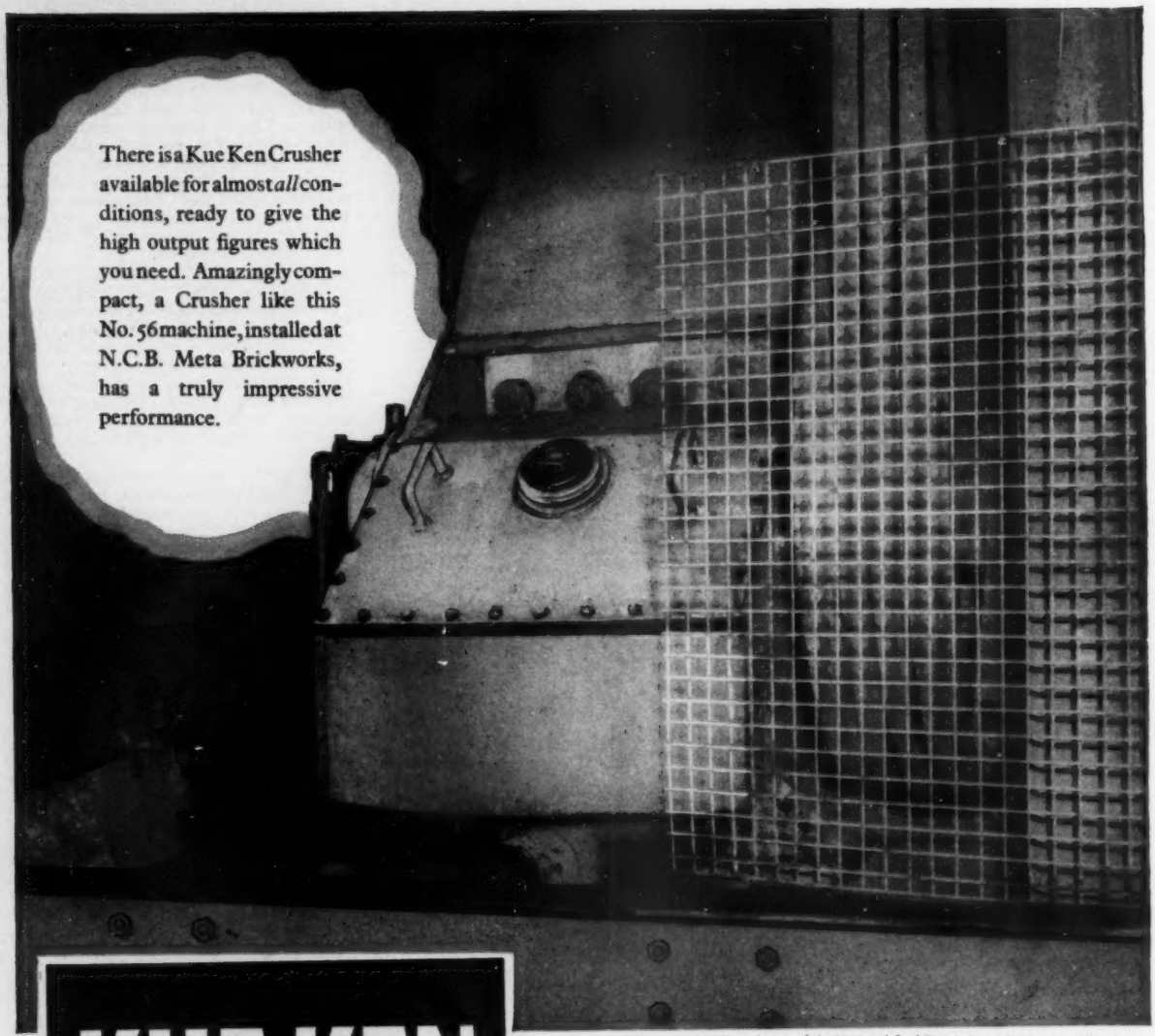
In Virginia, a Zeni core drilling machine has completed seven 6 ft. diameter shafts. This machine, product of the Zeni Corporation, is the result of several years' research into the design of large diameter coring drills. Claimed to work satisfactorily in any diameter from 5 ft. to 8 ft. and with no practical depth limitation, the machine is illustrated diagrammatically in *Fig.* 14.

The cutting edge is in principle the same as in oilfield rolling cutters, but taking a wider 4 in. kerf and larger diameter core. The entire machine, together with the operators, is suspended in the hole by a cable and is firmly anchored against the sides by hydraulic horizontal jacks. A vertical thrust jack operates against these, so applying pressure to the cutting edge. The power to the cutting rollers is via a 25 h.p. motor mounted just below the operator's platform. A 7½ h.p. vacuum pump serves the dual purpose of exhausting the cuttings and providing cooling air to the cutter bearings. The cuttings are deposited in a Calyx under the motors.

It is conjectural whether or not the Zeni drill has an application in hard rock mining—particularly with the larger diameter shafts. Quite apart from the greater difficulty of cutting a hard rock kerf, the removal of the core would present a problem. The snapping off of such a core would not be so facile as with sedimentary rock and too liberal a use of explosives would present the sinking engineers with the unenviable task of mucking out several tons of debris—without easy means of disposal.

During 1957 details were published in Britain of the strides the U.S.S.R. mining industry is making in an endeavour to speed up the shaft sinking programme. An interesting machine designed for the sinking of small shafts is the R.T.B. jet turbine. This comprises three or four turbo-drills which bore out the complete shaft to a diameter of some 6-7 ft. The drills, powered by the mud flush, are each fitted with three roller bits of 19.75 in. diameter. The turbo-drills are mounted parallel to each other along the diameter of a frame suspended from the surface. Each drill rotates independently and, in addition, the entire holding frame rotates about the central axis of the shaft. Thus the entire shaft face is broken up and the debris is removed by the mud flush as it leaves the turbo-drills. No details of the performance of this machine are so far available.

BIG performance in small spaces



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Other machines have been developed on the Continent, designed to speed up the driving of small diameter shafts. The advantages of cheap access or ventilation shafts are becoming increasingly recognized. Many of these auxiliary shafts are equipped with self-service Koepe hoists; at one such installation the management claim that the saving in underground travelling time from provision of an access shaft more than recovered the sinking cost in six months.

RADIATION TECHNIQUES IN MINING

Besides contributing to the world's power requirements, atomic energy is also being utilized to help the mining industry in many varying ways by making available a wide range of individual radio-isotopes for measuring and detecting. Radioactive dynamite has been used underground in a series of trials in Canada, aimed at reducing the number of accidents due to unexploded powder left in holes or muckpiles after firing rounds. The radioactive dynamite was prepared by introducing a small amount of antimony 124 into the explosive, the strength of activity being such as to make a fair size portion of the powder readily detectable by a portable Geiger counter.

The Canadian tests showed that 250 lb. of explosive marked with 7 milicuries of a tracer element such as Sb124 can be manufactured and handled safely and without deterioration of the explosive. The use of radioactive explosive does not, however, appear a very practicable proposition. Apart from the increase in cost of treated explosive and the equipping of miners with detectors, there is still the need for a careful and systematic search of the face and the muckpile. If one accepts that this need is essential the desired result is just as easily achieved by the standard procedure of washing down and examination.

The British National Coal Board have been using radioactive drill tips to measure the rate of tip wear. By rendering the tip of a drill radioactive by neutron radiation, its rate of wear can be measured by the radioactivity of the chips. A figure for wear can be obtained to an accuracy of ± 5 per cent from 12 in. drilling. This method has been used by the N.C.B. for the laboratory study of wear on tungsten carbide/cobalt drill tips in research on rock drilling and determination of the optimum compositions of tips.

An alternative method of investigating drill tip wear employed in Sweden incorporates Co^{60}, Ta^{182} or W^{185} into the carbide cutting edge before carrying out the test drilling.

Work has also gone on during the year in Britain, U.S.A. and the U.S.S.R. to develop radiation techniques by means of which coal can be sorted from shale.

SAFETY AND HEALTH

Solid CO_2 as Fire-Fighting Agent

Used by the North Range Mining Co. to fight a dangerous mine fire, solid CO_2 dropped directly into the fire area had the combined effect of reducing the temperature and excluding oxygen by means of a gaseous carbon dioxide blanket. The fire was extinguished in 18 hours and a lengthy shutdown averted.

It is becoming increasingly realized that maximum safety and high efficiency are closely inter-related determinants in good mining practice.

In the American coal industry safety is being promoted by the launching of a national campaign having as its objectives the reduction of roof fall accidents by 50 per cent improvement in mine lighting and more efficient dust suppression.

The U.S. Bureau of Mines plans to extend its health and safety activities connected with metalliferous mining during the current year and additional funds have been appropriated for this purpose. New activities are to include a study of protection against exposure to radioactive ores and the testing of respirators for protection against radioactive gas and dust. This probably follows from recent work by the U.S. Dept. of Health, Education and Welfare.

President F. G. Pardee, of the American Iron Ore Association, pointed out at the 1957 A.M.C. that 80 to 90 per cent of all accidents, regardless of industry, are caused by human failure. This indicated safety education as the most effective approach to accident prevention. These sentiments are largely borne out by findings at the Ray Mine, Arizona, where, over a period of three years, the injury rate has been cut from 40.90 to 11.71 per million man hours.

Promotion of safe working methods reaps fruitful rewards in reduction of working costs, improvement of the status of the industry in the public eye, lower labour turnover and improved industrial relations, and few would now deny that good safety is indispensable.

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S.M.Q.2

Open Pit Mining

By D. SUTTON, B.Sc., A.R.S.M., A.M.I.M.M.

WITH the advent of an embarrassing world over-production of minerals, many mines are, for the time being, faced with the alternatives of either producing at lower cost or not producing at all. This situation has thrown into even greater relief the advantages of low-cost open pit production, emphasis now being placed on improving efficiency rather than on expanding output.

The general trend towards increased size in excavating and transporting equipment continues, though perhaps at a slackening pace. Operations research methods are playing an expanding role in the improvement of operating techniques. In new equipment elaborate provision is made, through painstaking design, for ease and speed of control, in an endeavour to improve operator effectiveness and so obtain better performance from the machine.

DRILLING DEVELOPMENTS

The overall picture is somewhat obscured by the increasing availability of more than one type of machine for a specific job, improved efficiencies of some older machines, wide variation in conditions from place to place, and a natural reluctance to generalize on limited information.

Despite the comparatively high initial cost of rotary drills, the application of air-flush rotary drilling in the preparation of overburden continues to increase. Rotaries have been found to give less favourable results, however, in poor breaking ore and on rough terrain.

An increase in the use of percussive down-the-hole units is anticipated in hard, abrasive ground where wear on rotary bits is high. Bit sizes are expected to increase beyond the present maximum of 7 in. diameter.

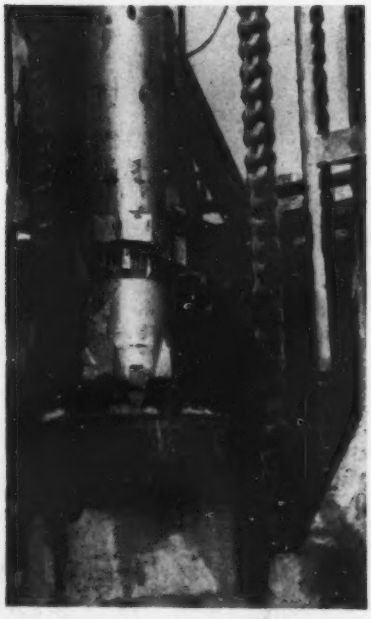

Fig. 1. Gardner-Denver "Mole-Dril"

Gardner Denver have recently introduced a percussive down-the-hole attachment, known as the Mole-Dril, for fitting to any rotary air-flush blast hole drill in the 4¾ in. to 6½ in. size range (*see Fig.* 1).

It would appear, however, that a place still exists for that old and trusted warrior, the churn drill. This position may be modified as existing equipment falls due for replacement, but the opinion has been expressed that churn drills are preferable to other types on small, rough areas. Certainly much has been done to improve efficiencies. At the U.S. Steel Corporation's Pilotac Mine, for example, bit change footage in taconite has been increased from 3 ft. to 10 ft. and drilling speed from 10 ft. to 30 ft. per shift, so making a choice between churns, rotaries, percussive units and jet piercers less clearly defined. At this mine the factors investigated included the clearance angle behind the bit cutting edge, proper control of tempering hardness, optimum tool weight, stroke length and repetition rate and general drilling technique. Since the quantitative results of this investigation would not necessarily apply elsewhere, figures are not quoted. Regarding technique, however, it was found important to watch for the bounce of a dull bit and then to work in a new bit using tight line and reduced speed in order to avoid premature bit damage and subsequent presence of tramp iron in the hole.

In pioneer work, as well as where good fragmentation is especially important or difficult to obtain, there has been a rapid growth in the application of mechanized and self-propelled percussion units. A good example of this type of equipment is illustrated in *Fig* 2. Bit sizes range from 2¾ in. to 5 in. Smaller percussion drills are especially suited to blocky ore.

An interesting addition to this class of equipment is the German Demag drill waggon, which mounts a rotary percussive machine capable of drilling a 3 in. hole to a depth of 80 ft.

Percussive roller-cone and turbo-drilling developments are reported from the oil industry, either of which may well find an application in mining in due course.

The first of these entails the addition of percussive impact to rotary bits of the roller-cone type. According to a Russian report, such a system increased the penetration rate of a roller-cone bit in hard limestone by a factor of no less than 15.

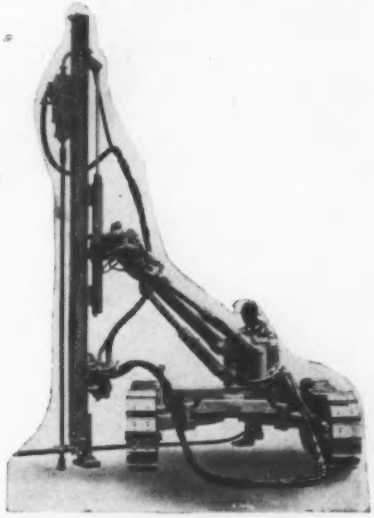

Fig. 2. The "Crawl-1R" drill wagon with full remote control

By courtesy of Ingersoll-Rand

American Gulf Oil have developed a down-the-hole well drill which has quadrupled drilling speeds through hard rock. This drill incorporates a reciprocating piston powered by the drilling fluid.

The first turbo-drill to be used in Britain is a French machine now under test in Nottinghamshire. The Russians have had such a drill for several years and the American Dresser Industries have carried out tests on the down-the-hole turbine principle in an oil well application. First indications are that penetration rates with the turbo-drill can exceed by 250 per cent those obtainable with out-of-the-hole rotary drive—but only under conditions favourable to the new method; i.e., in deep holes where bit wear is not excessive. Present designs are only suitable for exploratory application.

COMPARATIVE PERFORMANCES IN HARD ROCK

Model	*Type*	*Hole Size*	*Bit Life*	*Footage/ Shift*	*Tons/ Drill Shift*
Bucyrus Eerie 42 T	Churn	9¾ in.	33 ft.	10½	1,285
Joy 60 BH	Rotary (steel roller-cone)	9⅞ in.	600 ft.	115	6,485
Gardner Denver DH 143	Percussive Airtrac	5 in.	350 ft.	170	4,210
I.R. Drillmaster	Down-the-hole percussive	6½ in.	1,600 ft.	90	2,925
Joy Challenger	Percussive	4 in.	570 ft.	170	2,720

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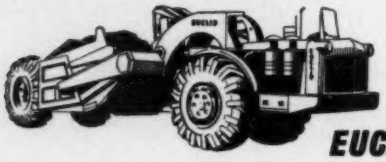

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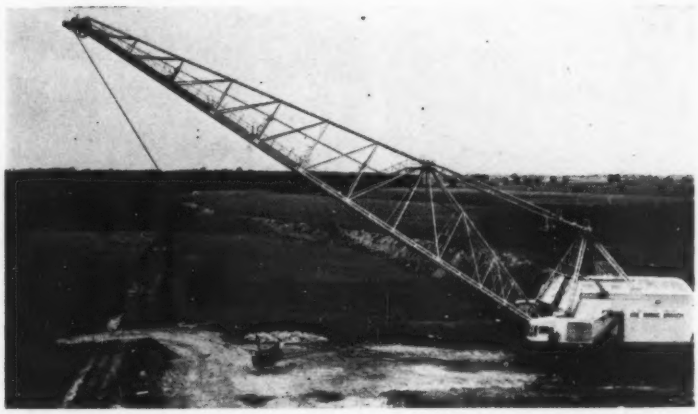

Fig. 3. The W1400 walking dragline

By courtesy of the United Steel Companies Ltd.

From the American Benson iron and titanium mines comes a useful comparison of performance in hard rock of the various types of drilling machine in current use. (See Table on page 105.)

Horizontal Holes

Advantages to be gained from drilling small diameter upwardly-inclined bench holes from the quarry floor instead of vertical holes from the bank top include smaller hole deviation, ease of exact burden measurement, and working off a level floor. This was recognized in Germany several years ago, and experience there to date has shown that low benches in hard rock up to 30 ft. in height can often be worked more efficiently by this means. In one application holes up to 60 ft. deep are drilled in two rows, one row being near the floor and horizontal with the second immediately above and drilled with upward inclination to end at about half the face height. Good and uniform fragmentation results.

A new design of horizontal overburden drill is reported from the Victoria open pit coal mine, Indiana. Known as the Joy 398 SB, this machine embodies vertical air-flush rotary principles, a further feature being its ability to drill to a depth of 48 ft. in one continuous run. Operated by one man, holes are drilled into an 80 ft. high bank on 20 ft. centres to prepare sufficient overburden for removal by means of a 40 yd. shovel.

BLASTING TRENDS

Ammonium Nitrate

A dominant factor in open pit blasting during the past year has been the enormous growth in America of the use of ammonium nitrate explosives. An earlier trend has been accelerated by the use of fuel oil as an additive which, compared to solid fuels such as carbon black, sulphur or sawdust, results in an increase in the velocity of detonation from 2,000 M/sec. to between 4,000 and 6,000 M/sec. The minimum hole diameter for self propagation is reduced from 9 in. to about 2½ in. by the same means. This enables ammonium nitrate explosives to compare very favourably in everything except water resistance with the much more expensive gelatinous types.

Use of discarded lubricating oil as an additive in place of fuel oil has been largely discontinued, since tests showed that sludges contained in old oil are liable to impair percolation.

Savings in the cost of explosives effected through use of ammonium nitrate have been as high as 50 per cent.

It has been pointed out by a representative of the Monsanto Chemical Company that a dangerous mass limit for ammonium nitrate is reached at 123 tons, above which level a fire can lead to a detonation. Storage is therefore advocated in 40 to 50 ton stacks, separated by 6 ft. of intervening space and light metal partitions.

New Materials, Techniques and Ideas

Use of high and low velocity explosives in adjacent holes fired with alternate millisecond delays has given good fragmentation in a tough limestone. The low velocity holes, initiated fractionally before the adjacent high velocity ones, pre-stress the ground in a manner conducive to shattering.

Wider application of the blowing of powder explosives into horizontal holes is anticipated. Such holes are more usual in overburden preparation, but their use is extending into the breaking of ore.

A less expensive type of detonating fuse known as "Detacord" has been introduced by the Ensign-Bickford Co. for work akin to secondary blasting and longhole mining. The new product has a smaller core of PETN than "Primacord."

The danger of cut-offs occurring in closely-spaced holes fired with detonating fuse and with MS connectors between holes should not be overlooked. Especially in jointed rock, movement of ground between holes can occur ahead of the delayed detonation front, giving rise to troublesome misfires and inefficient breaking. The use of short delay electric detonators largely overcomes this difficulty.

POWER SHOVELS AND DRAGLINES

Economic examination of extreme size in equipment used to remove increasing depths of overburden continues to warrant still further expansion, despite the attendant heightening of maintenance problems. Indications are that special tools and devices will be developed to handle the large machinery involved rather than that maintenance costs will get out of hand through lack of them.

Emphasis has intensified on operator comfort and on ease of operation in new equipment designs, in accordance with a need disclosed by efficiency engineering methods. Operator visibility has received special attention.

Pride of place as the world's largest power shovel now goes to a 70 yd. unit which went to work in Illinois during the year. Several units of a similar type are under construction at the present time.

Work in progress at the Acorn Bank open cast site, Northumberland, where a world record output of 20,800 tons in a week was achieved last year. The photograph shows a 1150B, 25-yard Bucyrus-Erie dragline and a Butters derrick with a 5-ton grab in operation.

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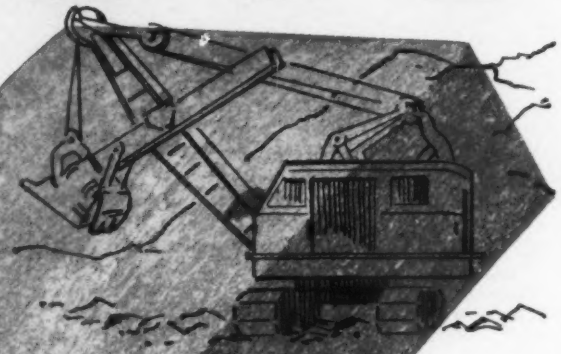

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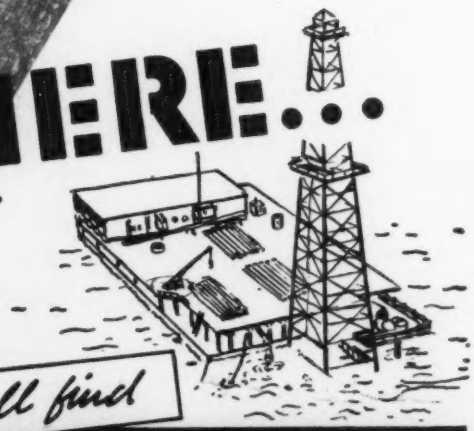

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A second Ransomes and Rapier W 1400 walking dragline (*Fig.* 3) is now in operation in this country at the new United Steel Co.'s Eaton Park open pit ironstone mine. This is claimed, at 1,675 tons, to be slightly heavier than the similar machine which has been in use for several years at the Corby open pit mine of Stewarts and Lloyds Ltd., but assignment of a weight to such equipment must surely border on conjecture.

A useful size-cost comparison on 6- 8- and 10-yd. shovels was presented by E. F. Hanson of the Utah Construction Co. at the 1957 AMC. The findings were that the larger shovels can do almost anything of which smaller shovels are capable, and do it better at lower cost per ton. The larger units show up to particular advantage in hard digging. Direct cost per ton excavated does not appear to vary much with size, although the large shovels naturally produce at a higher rate.

Crawler Tracks in Rock Work

The short life of crawler tracks in hard rock work has long been a major cause for concern on account of trouble with track shoes, rollers, idlers, links, bushings, final drive sprockets and the like, which has all led to untold expense in maintenance costs and loss of production. According to the Caterpillar Tractor Co., however, this position is often capable of improvement through choice of suitable equipment. For example, narrow double-grouser track shoes should be specified and roller guards used to prevent rock feeding in between rollers and track where it can cause serious wear, especially if the track is adjusted too tightly. Guards also reduce wear on roller flanges in steep and rough going.

RUBBER-TYRED TRANSPORT

Here the trend is again towards a moderate increase in size of the largest units, use of high-strength steel alloys for weight reduction and painstaking attention to ease of control as well as operator comfort in general.

Where last year the 50-ton truck was the largest unit available "off-the-peg," this position has now been modified by production of a standard 64-ton unit.

Incorporation of oil retarders is favoured in new trucks, with a view to reducing gear changing on down-hill hauls, thereby increasing safety and reducing maintenance. A compression retarder is available for the same purpose.

Electric Wheel

An all-wheel direct drive system incorporating an electric motor within the hub of each wheel has been designed by Le Tourneau for rubber-tyred earthmoving equipment. This system has already been proved in large-scale cross-country transport equipment, both military and industrial, but its application within the mining industry represents a new departure. Its importance lies in the elimination of complex power transmission trains and in provision of maximum tractive effort. The power supply to this unit is derived from a diesel-electric generator.

Compressed Air as Ice Preventative

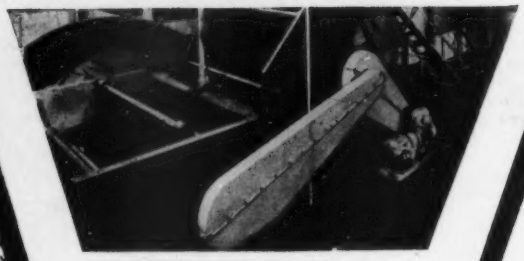
An idea taken from the Canadian lumber trade has enabled all-year-round operation of a suction dredge at Port Radium and might well find wider application in far-northern regions. Compressed air pumped through submerged perforated plastic pipes causes sufficient water circulation to prevent a freeze-up where ice 5 ft. in thickness would otherwise form during the winter months.

Safety

In open pit work, as in other phases of the mining industry, all the evidence is in support of the view recently expressed by the American M. A. Hanna Co. that at least 75 per cent of accidents are attributable to human failure. This view is born out by J. H. Bird of the U.S. Bureau of Mines, who in his wisdom believes training and education to be the essentials of a sound mine safety programme, together with realization on the part of management that good safety is good business.

Maintenance

The growing size and complexity of much of the equipment used in open pit mining to-day is placing more and more production responsibility upon the skill and efficiency of the maintenance engineers. The larger mines have reacted to this situation by placing more authority in the hands of the maintenance superintendent, and by the appointment and training of specialists in the various skills involved. It is a healthy sign indeed that scheduled maintenance programmes should have been universally accepted and their paramount importance emphasized by management.



Britain's first Drewboy dense medium plant

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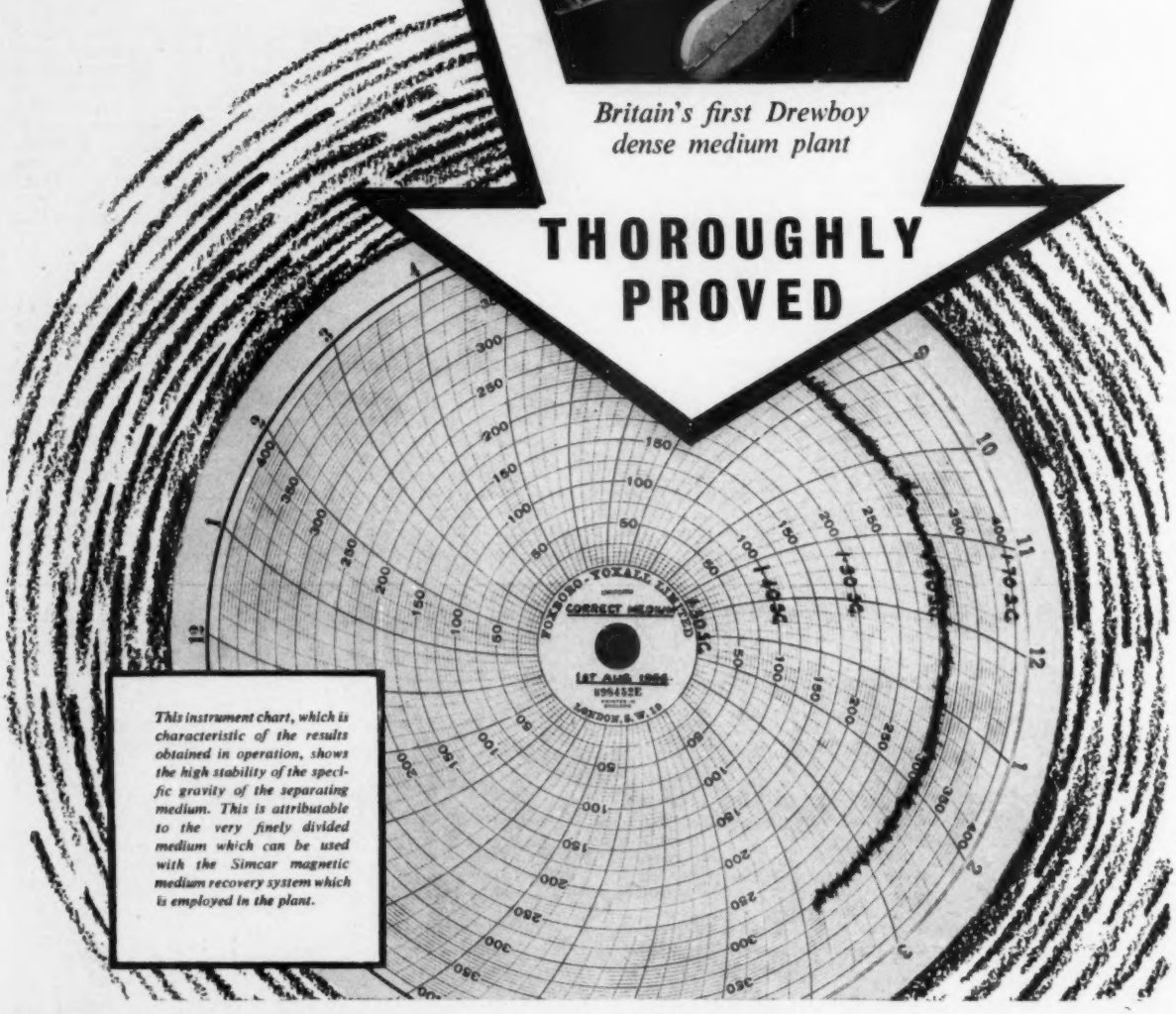

This instrument chart, which is characteristic of the results obtained in operation, shows the high stability of the specific gravity of the separating medium. This is attributable to the very finely divided medium which can be used with the Simcar magnetic medium recovery system which is employed in the plant.

The success of Britain's first Drewboy dense medium washing plant—designed and built by Simon-Carves Ltd. at the Rossington colliery of the National Coal Board—has now been consolidated by orders for two further plants of this type received by Simon-Carves Ltd. from the National Coal Board. The first of these is a 150-tons per hour plant at Baddesley in the West Midlands Division and the latest order is for a 200-tons per hour plant at Thorne colliery in the North Eastern Division.

These orders which are a consequence of the trouble-free and efficient working of the pioneer plant at Rossington confirm the reliability of the Drewboy two-product dense medium system which has now been thoroughly proved and can compare favourably with any competitive system in the world.

Complete coal preparation plants by **Simon-Carves Ltd**

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Coal Preparation

By ARTHUR GROUNDS, B.Sc.Tech., A.M.C.T., F.Inst.F., M.I.Min.E.

IN this review of recent developments in coal preparation, the term "recent" will be interpreted somewhat liberally, but will refer in general to developments which have taken place in the coal industry of the United Kingdom during the post-war period.

However, what is said concerning coal preparation in Britain is largely applicable to most European countries and to the U.S.A., where, in past years, the cream has been skimmed off the available coal and where there has been an increase in the dirt content and in the fines contained in the raw coal. In all these countries, dense-medium processes have made great progress and water clarification has become a serious problem.

Coal preparation plants, in the years prior to 1939, were mostly of low capacity, judged by present-day standards. There were, of course, some exceptions such as the washery at Ashington Colliery in Northumberland, which had a capacity of 400 tons per hour, but the average capacity of the washeries in operation even in 1946, was only 81 tons per hour. During the war, the installation of new coal preparation plants virtually ceased, since capital expenditure was confined to the direct war effort.

With the nationalization of the mines in January 1947, however, a great effort was made, in the first place to recondition those plants which had been built comparatively recently, and secondly to build new plants where these were required, either because the existing plants were in very poor mechanical condition due to lack of maintenance, or old age, or at collieries where no preparation plant had previously existed or at completely new pits or at pits where the reorganization scheme was designed to give increased output.

Large Plants

In contrast to an average capacity of 81 tons per hour in 1946, the average capacity of the new washeries now under construction in the U.K. amounts to approximately 300 tons per hour. Some of these plants could not have been built by private enterprise, particularly those having capacities of which are 600 tons per hour or over.

The first of these large plants was the Barvoys-Hoyois-froth-flotation washery which was commenced in 1946 at Mosley Common Colliery. This has a capacity of 600 tons per hour. The largest washery to be built in this country—and indeed in Europe—is that which was put into operation at Manvers Main Colliery, in Yorkshire, in 1956-57. This washery, which is shown in Fig. I, has a capacity of 1,320 tons of coal per hour. It is divided into three units, each capable of cleaning 440 tons per hour, and each comprising a Barvoys dense-medium plant for cleaning the 8 in.-2 in. coal, ACCO Baum boxes for cleaning the 2 in.-$\frac{1}{2}$ mm. coal and Denver froth-flotation cells for cleaning the $\frac{1}{2}$ mm.-0 fines. One unit cleans the strongly coking coals, the smaller sizes of which are carbonized in local coke-ovens, one unit cleans the medium coking coals which may be used for blending or are supplied to the Gas Boards for carbonization for town's gas manufacture, and the third unit treats the weakly-coking coals which are largely used for industrial fuel.

The washery is a central washery and draws coal from the four large pits Wath, Manvers Main, Barnburgh and Kilnhurst. All of the large coal is broken in Bradford breakers to a top size of 8 in. so that the whole of the raw coal is cleaned mechanically.

In each dense-medium unit of the plant, the specific gravity of separation is adjusted to suit the particular coal which is to be treated.

Middlings from the dense-medium plant, between specific gravities of, for example, 1.32 and 1.55, are either sold as a low-grade fuel or are crushed and washed with the 2 in.-0 coal in the Baum boxes.

The dense-medium used for separation is prepared from the tailings from the froth-flotation plant, these being classified to reject a considerable proportion of the −240 B.S.S. mesh fraction, and being free of any +60 mesh (B.S.S.) material which is removed by means of the dense-medium screens.

Each plant unit contains two ACCO Baum boxes of 175 t.p.h. capacity and each unit froth-flotation plant consists of three 6-cell banks of No. 30 Denver Sub-A Flotation machines. Cresylic-creosote is used as the frothing agent and each unit froth-flotation plant has a nominal capacity of 40 t.p.h. The filter-cake produced has an average ash content of 10-11 per cent and a moisture content in the region of 26-27 per cent.

The filter-cake and the $\frac{1}{2}$ in.-$\frac{1}{2}$ mm. washed small coal (which is dewatered in centrifuges) are mixed in paddle-mixers of the double-worm type.

Types of Plants in Use

It is interesting to compare the types of plant now in operation with those which will be used in the plants at present under construction or planned for future erection. Table I on page 113 enables such comparisons to be made and shows that the most commonly used cleaning unit in this country is the jig.

The hand-cleaning of the graded and large sizes of coal, however, is being gradually eliminated. In 1946, nearly 35 per cent of the total saleable output of coal was cleaned by hand, but by 1957 this figure had fallen to about 17 per cent. The reason is not far to seek. Hand-cleaning is costly and is also inefficient from the technical point of view. It is being steadily replaced by the use of dense-medium cleaning processes, as will be seen from the increase in the use of dense-medium units in Table I. It is also being partly replaced by using Baum boxes for washing coal up to 6 in. or 7 in. in size, instead of restricting their use to the cleaning of coal below 3 in. in size, as was common practice up to 1947.

As far as Britain is concerned, trough washers are not looked upon with favour. Our experience has been that they are too sensitive to variations in load and to variations in quality of the feed; i.e., the proportion of middlings and shale present in the raw coal. In addition, the recirculation of middlings containing shale may, if the shale breaks down easily, lead to the production of viscous clay suspensions which are troublesome from many points of view.

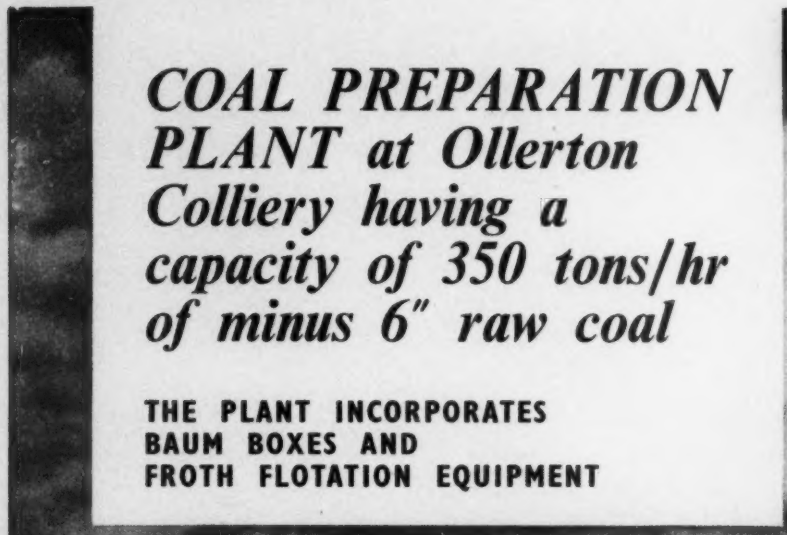
The adoption of dust-suppression measures has resulted in much of the raw coal produced to-day coming to the surface in a wet condition. This has led to difficulties in screening at small sizes and also in cleaning on pneumatic tables, since the small-aperture meshes and also the air-admission perforations on dry-cleaning tables easily become blinded. For this reason, dry-cleaning is steadily being abandoned in Britain, although a contributory factor is

Fig. I. External view of Manvers Main central washery, Capacity 1,320 t.p.h. of 8"-0 coal. This is the largest washery in Europe and commenced work in 1956/7. It is in three sections and prepares prime coking, medium coking and industrial fuels.

(By courtesy of the National Coal Board)

COAL PREPARATION PLANT at Ollerton Colliery having a capacity of 350 tons/hr of minus 6″ raw coal

THE PLANT INCORPORATES BAUM BOXES AND FROTH FLOTATION EQUIPMENT



Boom Loaders feeding Wagons

Battery of 14 Froth Flotation Cells

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P.4993

the low-efficiency of dry-cleaning systems as compared with that of wet-washing methods.

Mechanization

There has been a gradual acceleration in the application of mechanized mining since 1947. While the use of mechanical cutter-loaders has led to increased outputs, it has unfortunately also resulted in an increase in the proportion of shale contained in the raw coal and what is much worse as far as coal preparation is concerned, an increase in the proportion of small coal below ½ in. and more particularly of fines which are below ¼ mm.

In coal cleaning practice, it is the fines fraction which is the most costly to treat, both from the point of view of capital and operating costs. In the years around 1938-1948 the average proportion of fines in the run-of-mine coal varied from 2½-3 per cent, whereas the plants now under construction will have to provide fines-treatment plant for about 5.7 per cent of the run-of-mine coal, while in the projected new washeries this figure has risen to about 6 per cent and may even reach 10 per cent in a number of cases.

There were only about 20 small froth-flotation plants in operation in 1947, but since nationalization 108 plants have been built and put into operation. The frothing capacity in January 1947, was about 120 tons per hour, whereas at the end of 1957 it had risen to 2,700 tons per hour.

The effect of mechanization on the proportion of shale in the raw coal is equally pronounced. In one Division of the National Coal Board, for example, for every 100 tons of shale in the raw coal in 1939-41 there are now 190 tons in the same weight of raw coal. There is no discrimination with a machine and everything within its reach is loaded, whether coal or shale. When hand-getting was the rule, the miner was expected to refrain from loading shale of any appreciable size and was, in fact, penalized for sending up to the surface a proportion of dirt which was not unduly high.

It is impossible to give an *average* figure to express the size degradation which is taking place by the use of mechanical cutter-loaders, since so much depends upon the physical characteristics of the coal being mined, upon the type of machine used, the extent of shot-firing and other factors. Purely by way of example, however, an individual case may be considered, the figures relating to which are shown in Table II.

TABLE II

SIZE	*RUN-OF-MINE (machine cut and loaded by hand)*	*RUN-OF-MINE (cut and loaded by a shearer-loader)*
+3 in.	44.1%	9.0%
3 in.-2 in.	12.9%	7.8%
2 in.-1⅛ in.	9.0%	11.8%
1⅛ in.-0	34.0%	71.4%
	100.0	100.0

It will be noticed that for every 100 tons mined, 34 tons consisted of 1⅛ in.-0 small coal when the coal was machine cut but filled by hand, whereas to-day, in every 100 tons of coal mined there are 71.4 tons of 1⅛ in.-0 slack. But since output has increased with mechanization, for every 34 tons of slack produced in former years, there are now produced probably 90 tons in the same period of mining time.

The effect of this on washery capacity is, of course, serious. If, for example, under previous conditions, the washery had been designed to wash 170 tons of slack per hour (i.e. 34 per cent of 500 tons per hour of run-of-mine coal) it would to-day be faced with a quantity of 450 tons of slack per hour.

Such an increase would call for additional washing capacity but it might be found impossible to install additional units in the existing washery building and a completely new washery might therefore be necessary, since not only the washing units but also such things as dewatering screens, scraper conveyors, paddle mixers, etc., would be found to be too small for the additional load which would be imposed upon them in consequence.

Preparation Facilities

There is no doubt that more progress has been made, both in research and development as applied to coal preparation, during the last 10-15 years than during the previous century. In 1945, for example, only three systems of dense-medium washing were available in this country, whereas to-day there are ten. All of these originated abroad (five in the U.S.A., three in Holland and one in France) with the sole exception of the Ridley-Scholes process which originated on Tyneside.

Space allows of only a cursory mention of some of the new developments, but amongst these there are several outstanding processes or applications of plant used in other industries, which are of importance to coal preparation.

The new anti-pollution laws relating to discharges to rivers and streams have led to the development of methods of effluent purification, and to-day it is common practice to treat the tailings from froth-flotation plants in filter-presses in order to obtain a clear filtrate which may contain as little as 40 p.p.m. of suspended matter.

In this connection also, a whole series of new reagents and polyelectrolytes have been developed as flocculating reagents by firms such as Monsanto, the Dow Chemical Co., the Cyanamid Corporation of America, B.A.S.F. in Germany and latterly by the Yorkshire Dyeware & Chemical Co. Only minute proportions of these reagents are required in comparison with the weight of conventional starch (or modified starch) reagents previously used and different organic compounds are available to suit a range of circumstances. The cost is high but the low consumption of these new reagents often compensates for the high cost per pound.

We are only on the fringe of knowledge of flotation and flocculation fundamentals and a wide field of research is offered to organic and physical chemists.

In the field of screening, resonance screens, which have been used in Germany for a number of years, are now being made under licence in this country. They possess the merit of low power consumption in comparison with conventional jigging or vibrating screens and a considerable number are now on order for coal preparation plants, coke screening plants, and other equipment.

The hydraulic cyclone, developed before the war by Driessen and his colleagues in Holland, originally as a thickener and later as a washing unit using a suspension of magnetite as the medium, is a most versatile tool and is being used for many different purposes in coal preparation plants. The first cyclone washery to be built in this country (by the Coppee Co. Ltd. of London) was put into operation at Nine Mile Point Colliery in South Wales in 1957 and is working very efficiently on ¾ in.-0 coal at the rate of about 100 t.p.h.

These are merely a few of the new developments but coal preparation, which has for years been the Cinderella of the coal industry, is at last coming into its own, since many of the better seams of coal have been exhausted and are being replaced by inferior seams which, if they are to yield coal of the quality desired, must be treated in properly designed and very efficient coal preparation plants which effect the accurate separation of suitable products and thus ensure the maximum yield of combustible matter and the minimum loss of combustibles in the discard.

TABLE I

TYPE	*PLANTS WORKING*	*PLANTS UNDER CONSTRUCTION*	*PLANTS PLANNED*
	% of total working capacity	*% of total under construction*	*% of total projected capacity*
Wet Washers			
Jigs	69.9	58.5	62.5
Troughs	5.8	None	None
Dense Medium ..	11.4	35.8	31.6
Froth Flotation ..	3.5	5.7	5.9
Miscellaneous ..	1.5	None	None
Dry Cleaners	7.9	None	None
	100.0	100.0	100.0

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DENVER 'SUB-A' FLOTATION MACHINES (left)

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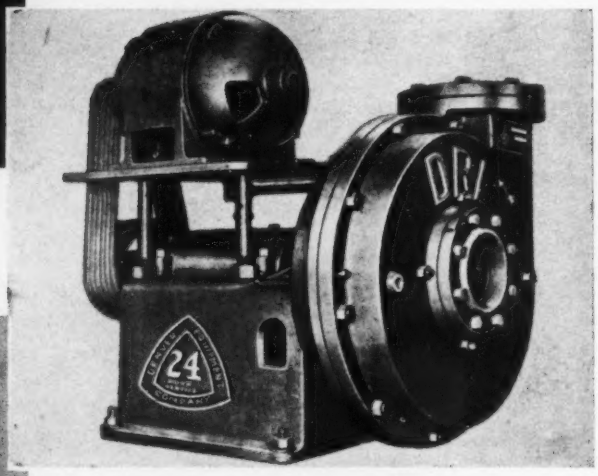

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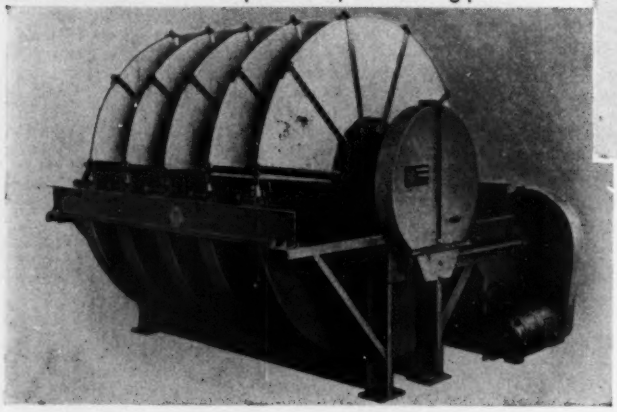

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Mineral Dressing

By F. B. MICHELL, B.Sc., A.C.S.M., M.I.M.M., M.I.Min.E.

THE past year has been characterized by a number of congresses and symposiums, including the International Mineral Dressing Congress in Stockholm and the 6th Commonwealth Mining and Metallurgical Congress in Canada, both of which had a very large attendance. In addition, there were the second Congress of Surface Activity and a symposium on coal preparation in the U.K., a symposium on coal preparation and symposiums on cyclones and dry classification inaugurated by the A.I.M.E. in the U.S.A.

Comminution

There has been no outstanding development in crusher design. In Germany many large crushers use fluid drives and employ an additional motor of larger size simply for starting.

Investigation of ball milling is still receiving a great deal of attention and specimen balls marked by means of neutron activation have been employed to study factors affecting wear.

It would appear from recent tests on Canadian nickel and iron ores that nickel alloys and nickel-chromium white iron liners have the best wear characteristics. Ball rationing has also received some attention and one writer has pointed out that if wear is regular, screen analysis of the media should yield a regular curve and deficiencies in certain sizes can be correlated with bulges in the curves of the screen analysis of the mill feed, and the crystal size. Such deficiencies can be made good by adding balls of the required size range.

Media composed of short cylindrical pieces of a compound based on sintered alumina having a high density and extreme hardness has been developed in this country for use in fine grinding of pigments and the like.

The validity of Rittinger's and Kick's theories has produced endless controversy for many years and whilst Bond's "third theory" advances an expression more nearly acceptable, modifications have been suggested. Holmes, in the Chemical Engineers' Symposium thought that a more general equation would be:—

$$W = W_i \left[1 - \left(\frac{1}{R}\right)^r\right] \left(\frac{100}{a}\right)^r$$

Where "R" is the reduction ratio, "a"—the 80 per cent product size and "r" is termed the Kick's law deviation exponent.

Essentially the same thing has been proposed by Svensson and Murkes who suggested at the I.M.D.C. in Stockholm the expression:—

$$W = E_o \left[\left(\frac{100}{K_{mp}}\right)^m - \left(\frac{100}{K_{mf}}\right)^m\right]$$

where E_o is a proportionality factor, and K_{mp} and K_{mf} are respectively the logarithmic mean particle size of the product and feed. They also prefer this mean to the 80 per cent size. The suggested value for "m" is between 0.8 and 1.3 and the findings are supported by considerable experimental evidence.

Recently Bond has suggested that as larger particles are most exposed to the work imput and are preferentially broken, it is possible to calculate an "exposure ratio" and that efficiency increases with the decrease in the exposure ratio.

The relative merits of low speed versus cataracting mills is apparently still in doubt when all factors are taken into account.

The super-critical speed grinding investigated by Hakki certainly now adds to the confusion although obviously with such high speeds, abrasion predominates, rather than cataracting.

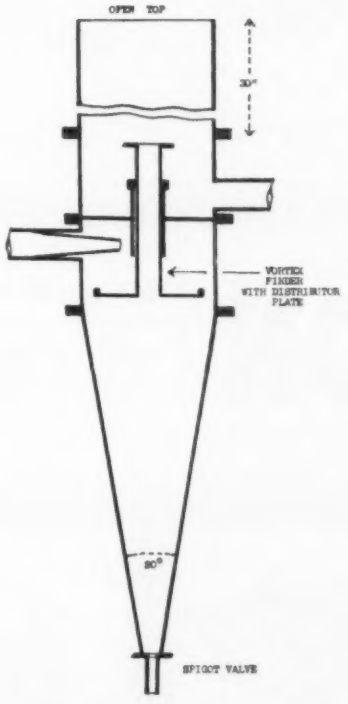


Fig. 1. Phoenix desliming cyclone

Although observers have noticed a divergence between the so-called "critical" speed and the actual speed where centrifuging occurs, Professor Hukki at the I.M.D.C. showed that mills can operate at perhaps 230 per cent of the "critical" speed (which has no visible effect on grinding), and asserted that the widely held belief that maximum grinding is reached at maximum power draft does not apply at super-critical speeds. Under these conditions an effective zone of comminution is formed between the outer layer of media and the shell lining, due to "slippage." but it seems likely that wear due to abrasion may be rather high in this area. The general conclusions are that fine grinding mills should have smooth liners and run in the super-critical range, the speed being related to the desired fineness.

The trend to replace fine crushers by rod mills is still apparent, and in some cases Aerofall mills have been employed in one step comminution. These mills are now being used at Coldstream in Canada, on uranium ores in Colorado, and one is being tested at Messina's Mangula mine, where it is said to be handling 1,500 tons per day. This mill is 30 ft. dia. and is the largest made up to the present, weighing 350 tons and carrying a live load of 70 tons.

As a result of examining operations in 44 Canadian mills, a relationship between the work index and liner shape, as well as work index and ball wear, has been established.

Screening and Classification

The D.S.M. Screen or "Sieve-bend" (originally described in the *Mining Journal Annual Review*, 1956) is finding increasing application and it is claimed that it can be used for separation as fine as 325 mesh. Tests on a tin mine indicate that it is quite efficient in the range 15 to 44 mesh and has a high capacity.

For fine wet sizing, inclined screens arranged with repulping pockets between short sections of screen cloth are also being used in some operations.

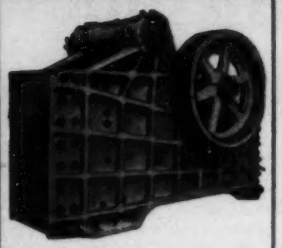
Since the adoption of hydrocyclones has been extremely rapid, there being no interest prior to 1948, it is not surprising that at least two symposiums were arranged dealing with this subject, whilst more than a hundred articles have been written in the last nine years.

In designing a cyclone, it is important to have the correct conditions, as well as the right size of body and orifices.

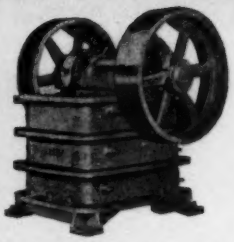
The size of separation depends on the body. For coarse separations, one should have high pulp density, and low feed pressure in a large diameter cyclone with a large vortex finder and a comparatively short conical section. The more coarse particles present, the coarser the cut, regardless of the diameter, so it may be desirable to scalp out these particles first. For fine separation, the density should be low, feed pressure higher (say 10 to 15 psi) with small cyclones using a proportionally smaller vortex finder and a longer cylindrical section, as well as a smaller apex angle.

Roughly, the combined area of vortex finder and feed inlet should be one-fifth or one-sixth of the cyclone's cross-sectional area. The presence of much clay causes coarser overflow, but the effect can be counteracted by using smaller cyclones and increased feed pressure. When aiming at desliming, low feed density is desirable and the underflow is usually fairly dense.

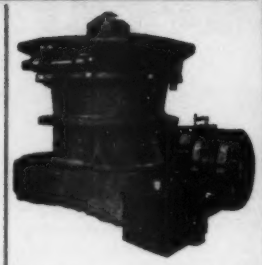
A low velocity open top cyclone with an adjustable vortex finder (*Fig.* 1) has been designed at the Phoenix Prince Mine, Southern Rhodesia. This design was adopted because of sudden variations in feed rate, so that a greater volume of pulp is maintained in the body, whilst the open top and provision of a flexible rubber apex nozzle tends to relieve pressure generated by



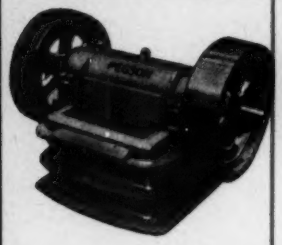
PEGSON DOUBLE TOGGLE ROLLER BEARING PRIMARY CRUSHERS. 60" x 48", 48" x 36", 36" x 24", 30" x 18", 24" x 13".



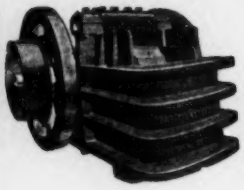
PEGSON-TELSMITH SINGLE TOGGLE ROLLER BEARING CRUSHERS. 10" x 21", 10" x 36", 14" x 24", 18" x 32", 25" x 36", 30" x 42" and 42" x 48".



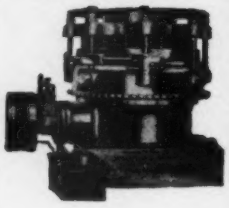
PEGSON-TELSMITH TYPE 'B' PRIMARY GYRATORY CRUSHERS. 8B, 10B, 13B, 16B, 20B, 25B, 28/30B.



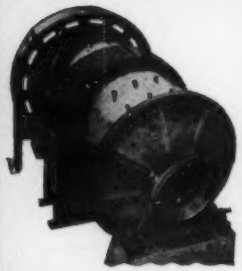
PEGSON ROLLER BEARING GRANULATORS. 24" x 5", 36" x 6".



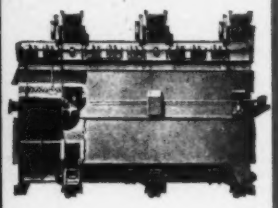
PEGSON PLAIN BEARING, DOUBLE TOGGLE CRUSHERS. 13" x 8", 16" x 10", 21" x 10", 25" x 14".



PEGSON-TELSMITH GYRASPHERE CRUSHERS. 24", 36", 36"7S, 48", 48"9S, and 66".



PEGSON-MARCY ROD AND BALL MILLS.



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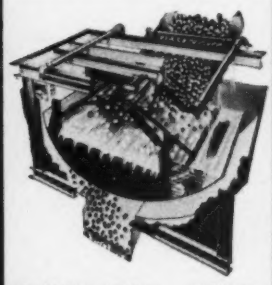

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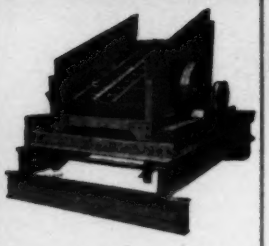
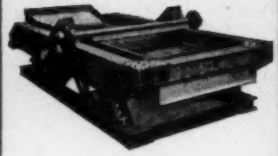


PEGSON-TELSMITH HEAVY DUTY SCALPING SCREEN.



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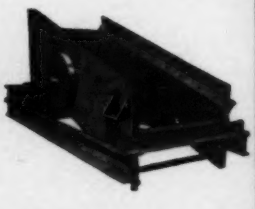

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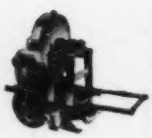

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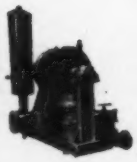

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a feed surge, since the former allows the pulp to rise in the vortex finder and the latter can expand to discharge at a faster rate under increased pressure. The open top design also allows the use of an adjustable vortex finder and permits an air column to form inside the finder when the spigot becomes crowded and the air entry at this point is stopped.

A cylindrical body (*Fig.* 2) has also been found to be suitable, allowing the sand to form its own cone, whilst a cone with a modified vortex finder has enabled it to be used as a thickener. (*Fig.* 1.)

Cyclones have been shown to be more efficient than conventional classifiers on high specific gravity ores and where magnetic iron ores tend to flocculate. These machines have one fault, however, namely, that they cannot tolerate changes in volume of feed and if these are likely to occur to any extent, the use of automatic control seems desirable.

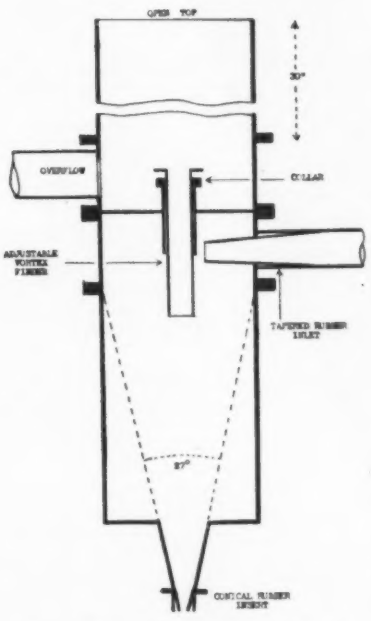

Fig. 2. Phoenix cylindrical cyclone

The A.I.M.E. also held a symposium on air classification during the year in which vortex classifiers, grinding and classifying in the sub-sieve range and problems of fine particle classification were discussed. Reference was made to Rumf's Mikroplex and the Sharples' classifiers.

Gravity Concentration

The behaviour of particles in jigging has been studied by Kirchberg and Hentzschel, who consider that it is incorrect to visualize the movement of individual particles, but that the bed of grains as a whole, together with the supporting and moving medium, should be taken into account. Apparently, there is a maximum height of stroke up to the point where the deposit is loosened through the harmonic pulsations of the medium. If the stroke is too great, the loosening wave cannot penetrate to the top, so that the upper layers are not influenced by the jigging motion and the optimum speed and stroke is reached when the volume of voids is about 60 per cent.

Fig. 3. "Vibrair" or pneumatic concentrating table

By courtesy of Knapp & Bates Ltd.

More was heard on the subject in the symposium on coal preparation inaugurated by the A.I.M.E. and one contributor stressed the importance of control, segregation of feed, fluctuation of feed and uneven distribution. These factors are often given too little attention in other fields, particularly in alluvial dressing.

It was also asserted that apart from heavy water requirements, the variation in the spigot discharges both in respect of quantity and quality caused variation in table operation and tended to nullify the advantages of a classified feed. This has been frequently observed in gravity treatment plants and although automatic control of the discharges enables accurate classification to be performed, fluctuations in the amount of feed offset to some degree the benefit which accrues from good feed preparation. It would appear that more attention could be given to hydraulic classifier design to correct this tendency.

Again this year more spirals have been put in operation—although some operators have preferred other means of concentration.

A modified form of sluice or launder concentrator has been devised by Cannon of Lakeland, Florida. Concentration is obtained during a quiet flow of relatively high pulp density (50 to 60 per cent solids) in a tapering launder, the heavy fraction near the bottom of the launder being removed by means of a curved discharge lip and suitable splitters.

With low grade ores, the high concentration ratio necessary is obtained by using three stages of counter-current recirculation.

The launders are arranged radially to form a circle, being fed at the wide end or periphery of the circle, so that a considerable concentrating area can be assembled in a compact fashion. Each unit, comprising 48 segmental launders, and about 7 ft. diameter, is said to have a capacity in terms of new feed (assuming counter-current recirculation) of 15 to 30 tons per hour. They are being installed by Union Carbide Ore Co. on their rebuilt dredge at Fernandina Beach, Florida.

A redesigned "Vibrair" or pneumatic concentrating table (*Fig.* 3) announced by Knapp & Bates Ltd., incorporates several improvements and has an extremely clean appearance.

Magnetic Separation

A new induced roll separator (*Fig.* 4) has been announced by Rapid Magnetic Machines Ltd., in which the magnet system has been redesigned with considerable reduction in both current consumption and overall size.

A 16 rotor unit has been built by Carpco which is said to handle 8,000 to 32,000 lb. per hour—at maximum flux, the separator produces 176,000 lines per sq. in., being the highest intensity machine that has yet been built.

Runolinna has shown that dry magnetic separation of finely divided magnetite ore is likely to be more efficient than wet separation, less cleaning stages being necessary, whilst the separators can be run at higher speeds and the loosening effect between poles is more pronounced.

The investigations were done on the Laurila machine with counter rotating magnets and drum and it was found beneficial to pretreat the feed with tall oil which reduced the tendency of the dry feed to agglomerate.

On the other hand, there are many operations which call for wet separation, and two new designs (*Figs.* 5 *and* 6) have been produced by Jones, using grooved plates or rings situated in an intense magnetic field. One utilized grooved rings in a rotating magnet system with the application of high pressure jets of scouring water, and the other a fixed bank of grooved plates through which the pulp is allowed to pass for a given time, after which the feed and flux is cut off and the machine flushed. This cycle is controlled by a camshaft operating the feed, wash and discharge deflector. Test results on fine wolfram ores (−100 mesh), 15 micron specular hematite and fine ilmenite appear encouraging.

Flotation

Since flotation depends on surface chemistry, no review could omit reference to the Second International Congress of Surface Activity which was held in London in the Spring of 1957. Approximately one-sixth of the papers dealth with surface phenomena connected either directly, or indirectly, with flotation.

Bickerman, in a paper on solid surfaces, pointed out that there was some danger in applying the laws of physical chemistry as established for gas/liquid interfaces to solid

Fig. 4. Rapid type 'M.J.' magnetic separator

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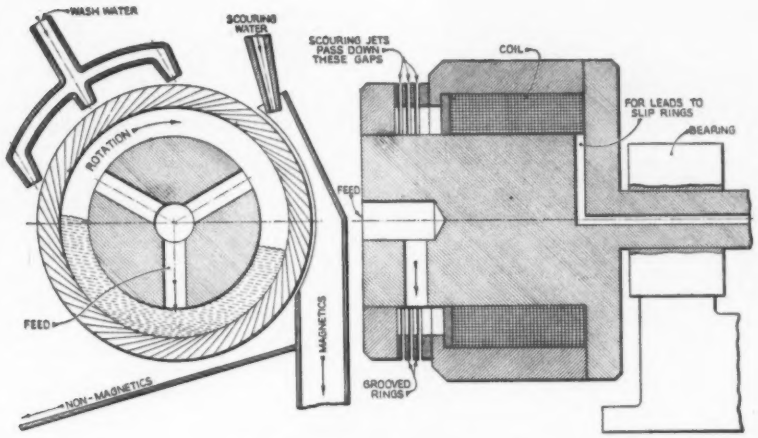

Fig. 5. Jones rotary-magnet machine

By courtesy of "Mine and Quarry Engineering"

surfaces. For example, surface roughness affects the conditions and it had recently been shown that the "stagnant" layer of liquid is about as deep as the surface valleys, whilst there was a considerable element of doubt concerning the application of Young's equation and the Gibb's adsorption equation to solids.

The Pethicas pointed out that the commonly assumed relation between contact angle and interfacial energies was only valid in special cases.

A new expression for obtaining the spreading co-efficient of a liquid on a solid surface was given by Paddey and the "Wetting of solid by solution as a function of solute adsorption" was discussed by Sasaki, Kumanomido and Tsunoda, whilst "The adsorption of Cationic agents by silica and octadecane" was considered by Elton.

Dealing specifically with actual flotation problems, Gaudin and others discussed "Native floatability and crystal structure." Two hypotheses were put forward to explain native floatability and the relation between floatability and molecular structure was discussed. Briefly, these authors suggest that native floatability occurs when some fracture or cleavage surfaces forms without rupture of inter-atomic bonds other than residual bonds, whilst the natural lack of floatability results when all natural fracture or cleavage surfaces offer ionic bonds to the surrounding liquor in greater density than some threshold value.

Plaskin (U.S.S.R.) dealt with "Using microautoradiography for studying the interaction of reagents with minerals" and described a procedure using photographic plates for examining the location of the adsorbed reagents. He shows that it is by no means regular.

Plaskin and Bessonov also considered the "Role of gases in flotation reactions," whilst Leja summarized the recent work at Cambridge on metal-monolayer reactions. This excellent paper covers many angles and is well worth a careful study by all metallurgists interested in flotation. It is suggested that when a particle becomes attached to a bubble, penetration of two "diffuse monolayers" previously present at the air/liquid and solid/liquid interfaces occurs.

Hydrolytic and ion pair adsorption processes as well as ion exchange and corrosion was discussed by Cook and Wadsworth and "Electronic phenomena accompanying the process of flotation" were considered by Pomianowski.

Leja and Nixon presented a paper dealing with "Ethylene oxide and propylene oxide compounds as flotation reagents" in which they assessed the value of these reagents (including such reagents as Powell's frother and Dowfroth) with different minerals and pointed out that it was possible to vary the hydrophilic portion of the molecule leaving the hydrophobic part unchanged.

In dealing with "Adsorption and chemical reactions of sulphydric collectors on galena surfaces as revealed by electron diffraction," Hagihara and others showed that adsorption of xanthate or dithio-phosphate on an unoxidized cleavage face of galena occurs on minute spots resting on the lead atoms of the lattice. Sato also discussed the action of aqueous heavy metal salts by a similar technique and showed that the exchange of metal ions from the mineral with metal ions of the solution appears to occur and is governed by the solubilities of metal sulphides.

Working on the infra-red spectra of xanthate compounds, Little and Leja reported that both cuprous and lead xanthate contain dixanthogen, but zinc xanthate does not. Bowcott, in studying the penetration by alkyl xanthates of monolayers of hexadecyl alcohol, an amine and an acid, suggested that the xanthate appears to be stabilized against atmospheric oxidation by an alcohol or an alkyl tri-methyl ammonium salt, whereas it was not affected by a fatty acid. On the other hand, a primary amine caused rapid hydrolysis of the xanthate ion at pH values above seven.

Rogers and Schulman dealt with the mechanism of the selective flotation of soluble salts in saturated solutions and suggested another explanation to the one of epitaxis. It has been discovered that the relative attraction of water molecules to the crystal surface controls the adsorption of the surface active agent. If the soluble salt has a sufficiently negative heat of solution, adsorption of the amphipathic ion is possible and flotation results, but if the heat of solution is positive, water molecules adsorb at the expense of the surface active agent, whilst water molecules within the crystal lattice do not necessarily prevent adsorption, but may make it possible.

The electrokinetic properties and surface reactions of scheelite were discussed by O'Connor, whilst Kakovsky described a study of some thermodynamic properties of sulphur containing compounds used as collectors and analysed the interacting forces. A review of coal preparation research carried out by the National Coal Board, including some 15 separate pieces of work, were described by Whelan, of which the most valuable was that relating to the contact time and induction time (see *Mining Journal Annual Review*, 1956). The flotation of beryl was also discussed by Patching.

In the case of quartz and dodecylammonium acetate, Fuerstenau has shown that there is a very close relationship between contact angle, adsorption density, zeta potential and flotation rate; in other words, surface phenomena reflect conditions at the solid-liquid interface and can be correlated directly with the floatability. If this is so, it refutes the common belief that adsorption and electrokinetic studies cannot be correlated directly with flotation.

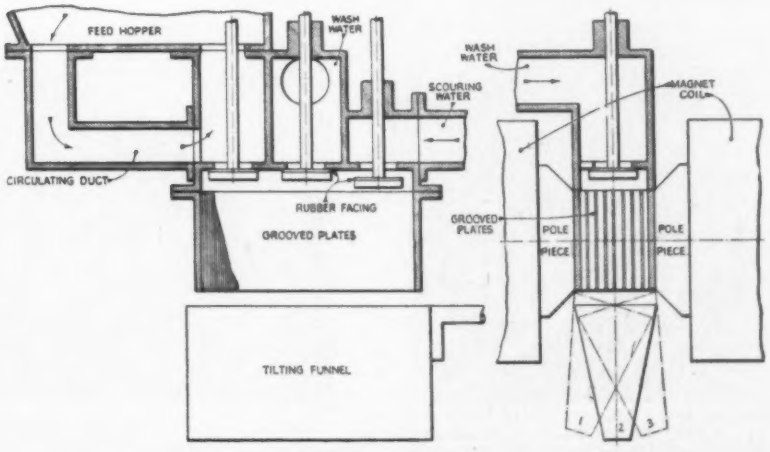

Fig. 6. Jones fixed-magnet wet magnetic separator

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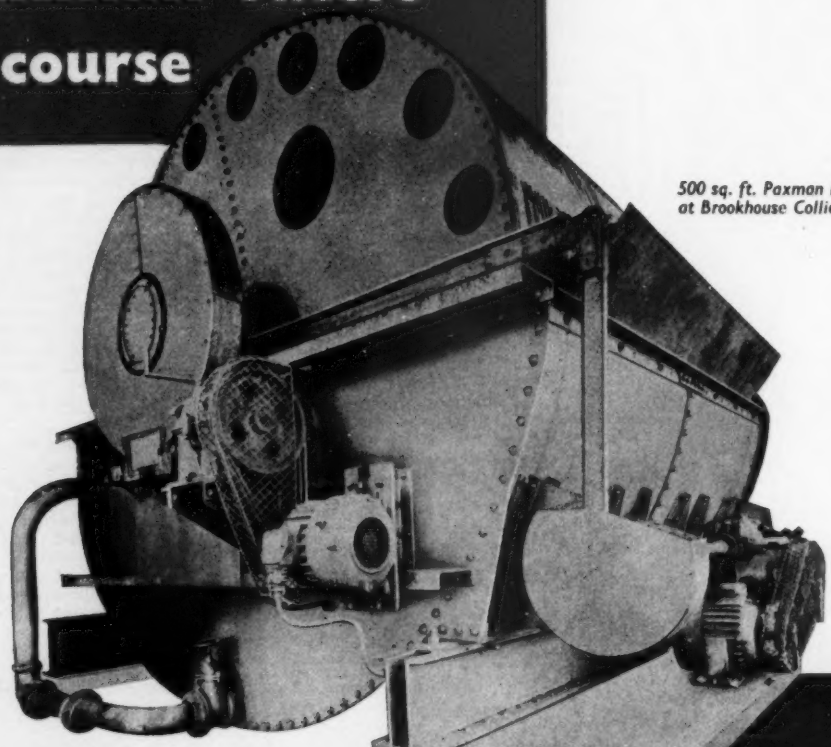

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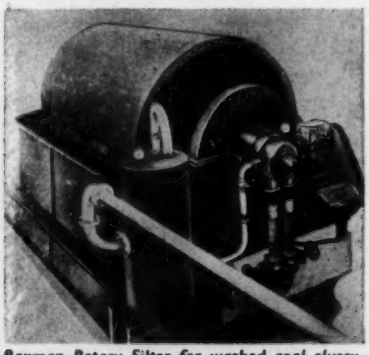
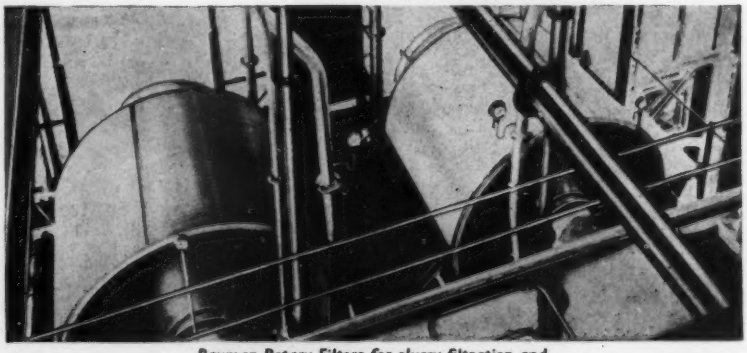


Paxman Rotary Filter for washed coal slurry, as supplied to Richard Thomas & Baldwins Ltd.



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At the same time, Fuerstenau has suggested that the variations in the flotation characteristics with pH can be explained by the adsorption density and the change in the zeta-potential.

The formation of chemical compounds between the metal ions from the mineral and fatty acids has been studied by du Rietz, using the solubility and the precipitation constant of the metal-collector salt, who has shown that the results are a clue to the selection of flotation reagents.

The activation of sphalerite has been further studied by Gaudin, Fuerstenau and Turkanis using silver salts. It was found that Ag^+ forms a silver sulphide layer on sphalerite resulting from ion exchange of two silver ions for one zinc ion in the sphalerite lattice. The exchange is proportional to the logarithm of time and proceeds until either of the reactants is consumed. In the absence of a silver complexing agent, excess zinc ions have no effect on the silver uptake, but in the presence of cyanide ions, the activation is prevented by bringing the ratio of silver to zinc ions in solution so low that insufficient silver is available. If, however, the sphalerite has already been activated with excess silver, cyanide ions can deactivate sphalerite, provided oxygen is present.

The mechanism of pyrite depression with alkali cyanide has been investigated by Majumdar, determining the rate of development of the contact angle and rate of its decrease with xanthate treated pyrite in water.

The author suggests that when pyrite is immersed in water, ferrous ions are first formed owing to oxidation and then become oxidized to ferric ions. Such ferric ions are capable of aiding xanthate adsorption. The surface layer of xanthate ions is not stable, however, as the ions become oxidized easily and although oxygen is necessary for initial surfacing, it can also cause a decrease in the contact angle. If copper ions are present, the destruction of the surface layer is prevented. When cyanide ions are present, they are strongly adsorbed by ferrous ions, but not by ferric ions. The moment the ferric ions are reduced to ferrous state by xanthate or other reducing ions which may be present in the pulp, the cyanide becomes an effective depressor.

More has been heard of flotation of soluble salts and Rogers has reported a study of the interaction of water molecules with the ions at the crystal surface of soluble salts and the way in which these solvent ion interactions govern the adsorption of collector ions and molecules. A reason for the differing behaviour of halite and sylvite is suggested. It is also suggested that the heat of solution of a salt is a useful measure of ion-solvent interaction and therefore flotation.

The results obtained in studying metal-monolayers in relation to flotation have been discussed by Leja and two possible mechanisms of adsorption considered. In one case, the bond is between the polar group and the counter ion with lateral bonds between the ions in the solid liquid interface, which leads to a development of an adsorbed monolayer and, if closely packed, prevents subsequent attachment of air bubbles. In the other case, the polar-group to counter ion bond possesses Van der Waal's bonds between the adsorbing species, leading to multi-layers which remain hydrophobic in character regardless of the number of layers.

Pryor and Lowe showed last year that the flotation of malachite could be related to the chemical nature of the pulp and recently have produced evidence suggesting that chemical changes which take place in the liquid phase of the pulp during conditioning, can be related to the floatability of the solids. Furthermore, these changes can be measured by standard analytical methods; for example, there is a connection between the copper in solution and the carbonate produced during conditioning and the per cent solids floated. It would appear that if the amount of hydroxyl present before conditioning exceeds the quantity that reacts with the carbonate in the malachite, flotation is depressed.

Mitrofanov and others, have investigated the effect of pH and electrolytes on the adsorption of diethyl-dithiophosphate and butyl xanthate. The results should be of interest to those concerned with selective flotation, particularly at low pH values. Another group of Russian investigators, Bogdanov and others, have recorded investigations of the action of modifying agents and conclude that the nature of the interaction between reagent and the mineral surface can be one of four types:

(1) Chemical interaction, both chemisorption and chemical reaction.

(2) Primary sorption (sorption of isomorphous ions on the surface).

(3) Potential determining sorption.

(4) Secondary electrostatic sorption in the diffused layer.

It is also suggested that depression is caused in certain instances by sorption of depressor in areas not covered by collector, making the hydrophilic effect greater than the hydrophobic effect, so that a depressor

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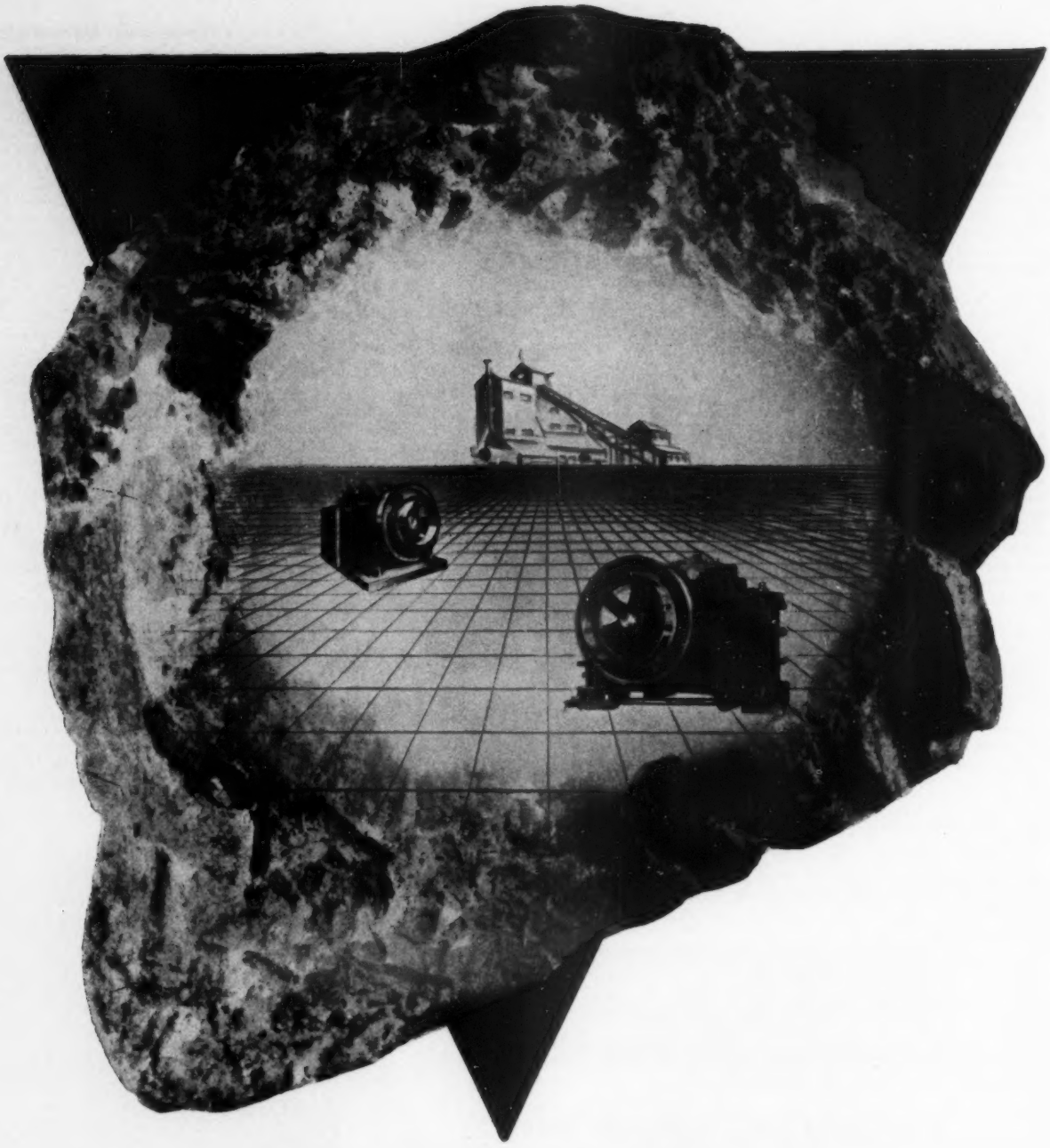

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may not necessarily be capable of displacing the collector ions.

Konev and Debrivnaja have shown from captive bubble tests that sodium sulphide is an effective desorption agent, not only for xanthate and dithiophosphate, but also for oleic acid in the case of sulphide minerals. A flowsheet has accordingly been worked out and, as a result, selective flotation has been replaced by bulk flotation, coupled with subsequent treatment involving conditioning with sodium sulphide, elimination of the reagents in solution by dewatering and washing, regrinding and reflotation. This technique makes a coarser grind possible and eliminates the possibility of interference by primary slimes and soluble salts, whilst lower tailing losses as well as higher grade concentrates are claimed.

Mitrofanov has also drawn attention to the use of sodium sulphide as a depressor in cleaning zinc concentrate contaminated with other sulphides and in the selective flotation of molybdenite.

Other interesting points are that activated charcoal has been used to remove certain reagents and magnanese-di-oxide has been found to be an effective oxidizer. This combination has been used for depressing arsenopyrite in a copper, lead pyrite concentrate, but apparently as much as 1.7 kg. of activated charcoal and 5 kg. of pyrolusite are required per ton of bulk concentrate treated.

An interesting bubble pick-up for rapid flotation has been described, simply using a tube with a piece of rubber tube, so that it can be used in the same fashion as a medicine dropper. The amount of mineral picked up by the bubble is a measure of the flotative properties and can be expressed as the "bubble load" of the amount picked up, or better, as "the pick-up index" which is proposed for the purpose of cancelling the idiosyncrasies of the bubble holder, etc. This is 100 times the ratio of the number of picked-up particles under the test conditions to the maximum bubble load of the same mineral under optimum flotation conditions.

Rey has attempted to classify lead-zinc ores as regards flotation based on the abundance and nature of the iron sulphides, the degree of oxidation, the basic or acidic nature of the gangue and the presence of copper minerals. Having grouped ores into four main types, he has reviewed the principal factors influencing the separation and the various possible procedures, producing a most comprehensive study of flotation practice.

More has been released about the novel agglomeration flotation process used at the Three Kids manganese mine, in Nevada.

The chief feature is the application of a great deal of mechanical energy during conditioning, which apparently causes the oil filmed manganese particles to collide, forming dense agglomerates. Apparently loose flocs first form, which are kneaded into dense agglomerate with more power imput, so that the gangue is squeezed out of them and yields a cleaner concentrate. Although the relationship between power imput and recovery varies considerably, it may be as much as 100 kw/hours per dry ton, and to achieve this degree of energy imput, a number of conditioning stages are required. Sulphur dioxide is used to condition the ore, after which a soap emulsion is added. As the soap is abstracted, the emulsion tends to break, freeing the oil which aids the agglomeration. Reagent consumption is very heavy, being from 25 to 40 lb. of soap and 120 to 180 lb. petroleum oil per ton.

The flotation of iron ores and the elimination of apatite has been studied at the Royal Institute of Technology, Stockholm, by Kihlstedt and others, examining fundamental factors and carrying out empirical investigations. The pH was shown to be an important factor and it was found that if emulsions of tall oil and fuel oil were used, desliming was unnecessary.

An interesting commercial flotation of low grade cinnabar ore has been developed in the Nevada-Oregon area.

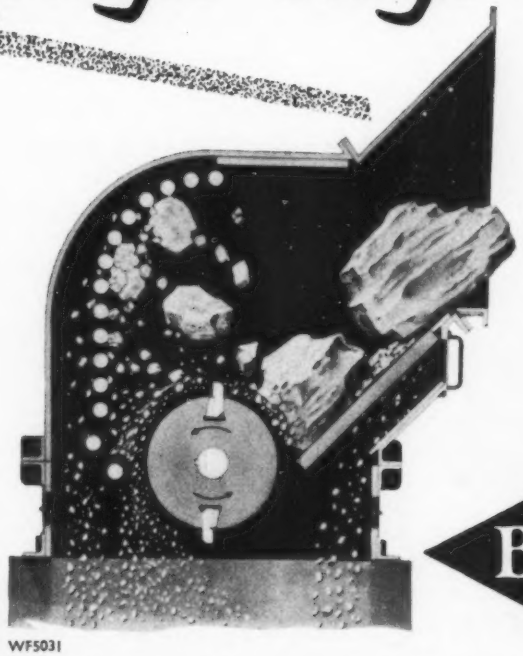
Instrumentation

Further extension of instrumentation is taking place and the operation of automatic controls in the grinding circuit of the Marmora iron plant, and at Bancroft Mine have been described.

The work done by Bushell and Malnarich at Sullivan has been extended in an attempt to achieve automatic reagent and pH control. For this work, a Beckman continuous measuring spectrophotometer will be used, along with a recording pH meter.

Instrumentation on the H & H Sink-float plant is also being studied and a continuous density recorder of the bubbler type has already made it easy for the operator to adjust the density of the medium and maintain it at a more constant level than by the old method of half-hourly density determinations. The next step is to add a controller, so that the density meter can be used to adjust the density of the medium.

Single stage impact crusher



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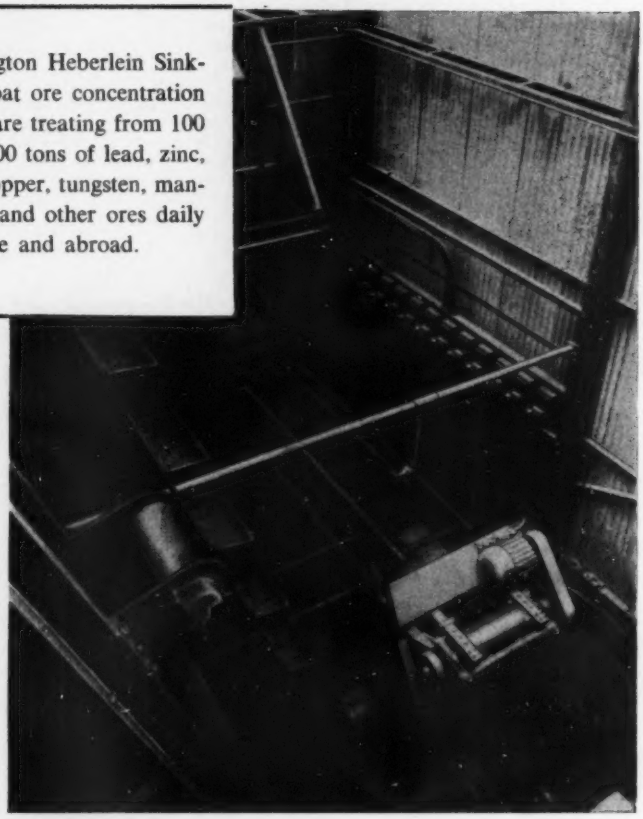

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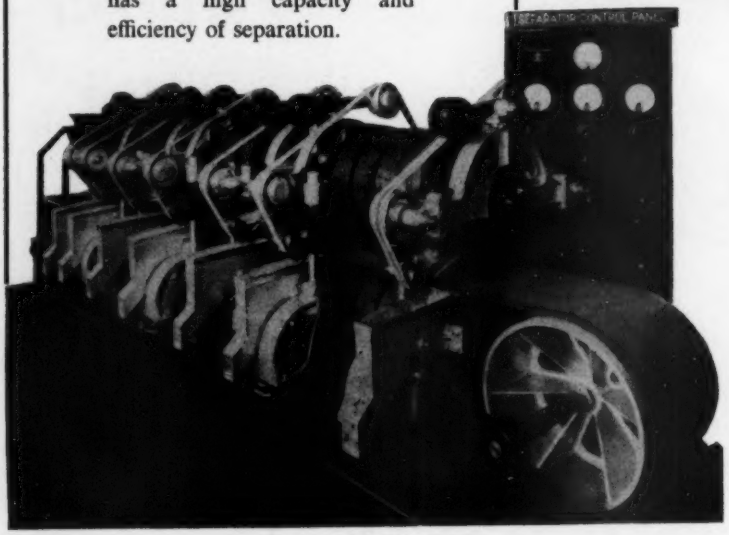

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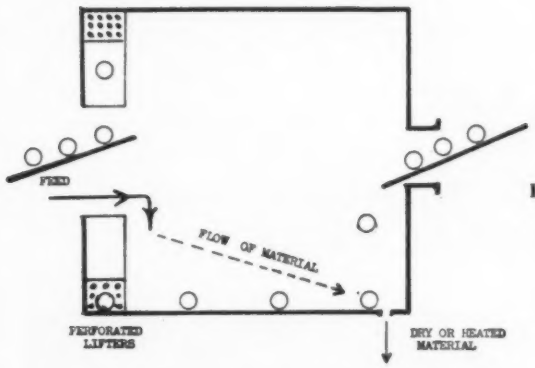

Fig. 7. Principle of solid-solid heat transfer

A new type of pulp density measuring device has been produced which depends on the attenuation of gamma rays by the solids on the new Jones and Laughlin tailing plant in order to obtain some degree of regularity in the discharge from the suction dredge. A similar device is now marketed by Bendix Aviation.

Ultrasonic absorption has also been shown to be a means of measuring pulp density and appears to be a practical method, provided no air bubbles are present.

Drying

The development of solid to solid contacting for heat transfer should be watched, since it may offer a solution to some of the more difficult drying problems and there appears to be some scope in coolers for this method. The process involves the passage of heated metal or ceramic balls against the flow of the material in a revolving drum (*See Fig.* 7) thereby effecting the transfer of heat by solid to solid contact, rather than solid/gas contact.

In this way it is possible to transfer more heat by moving a smaller volume of material. For example, 0.6 calories can be carried by 1 cc. of ceramic ball, whilst it requires 2,000 ccs. of air.

TREATING SPECIFIC ORES

Copper Ores: Operations at Union Minière have been described, including leaching techniques, flotation of oxidized ores, cobalt recovery by fluosolid roasting, followed by leaching and electrolysis, and by pyro-metallurgical means, using electric furnaces as well as the extraction of other metals.

In the treatment of oxidized ores, flotation, using hydrolyzed palm oil in a well dispersed pulp, is standard, although when cobalt oxides are to be recovered 5 to 7 per cent of tall oil is added to the palm oil. Flotation concentrate is difficult to filter, owing to the use of sodium silicate as a dispersant, unless the pulp is neutralized by addition of sulphuric acid to bring the pH to 7.2 and heated to 50-55°C. After sintering, the concentrate is treated in an electric furnace by a reduction process to yield a white alloy containing 42-45 per cent Co and a red alloy carrying 90 per cent Cu and some 5 per cent Co. Mixed sulphide oxide ores have been the subject of a great deal of research, but treatment has been finalized consisting of moderately fine grinding, followed by chalcocite flotation, using xanthates; then sulphidizing for malachite flotation and final regrinding and retreatment of the sulphide middling. The malachite flotation is said to be complicated, employing stage additions of alkaline sulphhydrate and amyl xanthate. Further separation of cobalt takes place after electrolysis in the copper refining.

The treatment of such oxidized ores is often a problem and a flowsheet involving leaching with precipitation and flotation has been described by Last, Stevens and Eaton at the New Orleans Symposium of the A.I.M.E.

This operation at Kennecotts' Ray mine involved precipitation of copper with iron sponge, followed by flotation at a pH of 3.8 to 4.0, using Minerec A and Pine oil. The modifications made to the flowsheet to incorporate this treatment involve desliming, the sand fraction being leached before fine grinding and flotation, whilst the slime fraction passes to the leach-precipitation-flotation section.

A dual leach flotation process was also put into operation early in the year at Consolidated Coppers' Inspiration mine in Arizona. In doing so, the company abandoned the almost classic acid-ferric sulphate leaching process, and now use straight acid leaching, followed by flotation of the washed residues. This has been brought about by the fact that some sulphides, notably chalcopyrite which has increased in amount, is relatively insoluble even when hot. In the modified plant the $-\frac{1}{4}$ in. ore is deslimed and the sand leached prior to flotation, but the slime is floated before leaching. The copper in the solution from the sand treatment passes direct to electrolysis, but the solution from the slime plant, after counter current decantation, is passed to cementation launders.

Uranium: In South Africa, 25 mines were producing at the middle of the year and more are due to come into operation shortly. In Canada, a number of mines have gone into production, varying from the 150 ton per day plant at Rayrock Mines, to the giant 5,700 to 6,000 tons mill of Consolidated Dennison at Blind River. Both plants employ acid leaching, followed by ion exchange columns and magnesia precipitation. (*Fig.* 8).

At Rayrock leaching is carried out after thickening, using 45 lb./ton sulphuric acid and 4 lb./ton sodium chlorate as an oxidizing agent. Liquid-solid separation is achieved by two-stage filtration, using Guar gum as a flocculating agent.

At Consolidated Dennison, the pulp is both thickened and filtered to achieve the correct pulp density before agitation, when nitric acid is added to assist the settling.

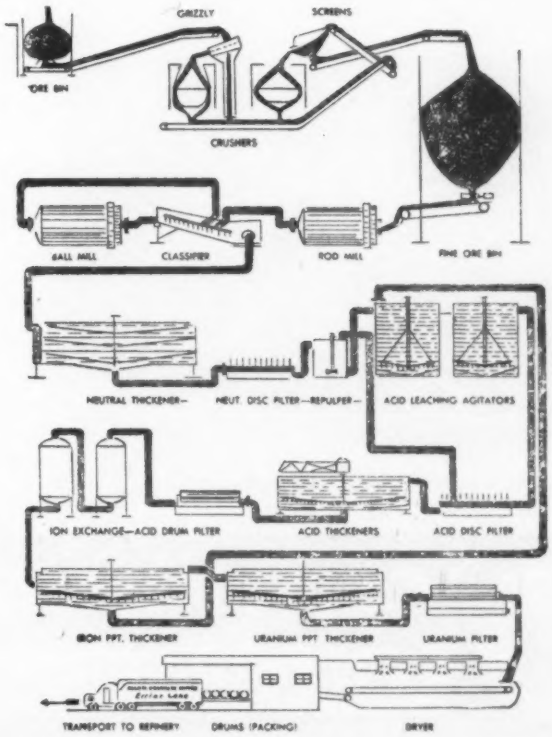

Fig. 8. Method used at the Algom Quirke and Algom Nordic mines, Canada, for the recovery of uranium

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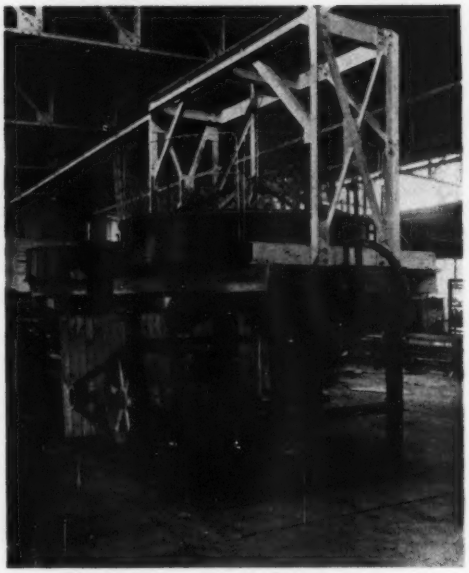

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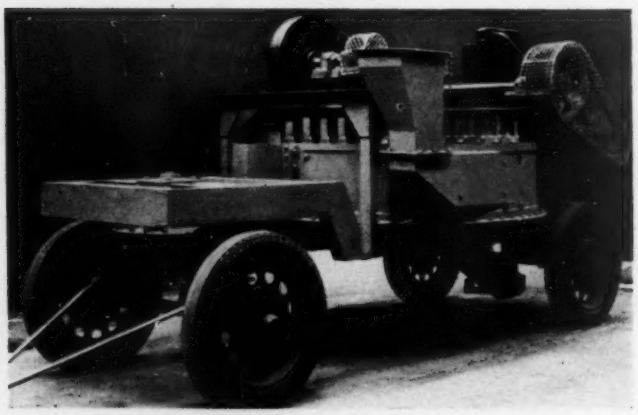

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Agitation and filtration follows normal practice. Other plants employ the resin in pulp method which is becoming much more popular and at least five plants now incorporate this process.

In the development of this method, various means of separating the resin from the pulp and for providing continuous operation were considered. Baskets were used which were removed periodically, screening the whole of the pulp, making a "magnetic resin" and so on, but the chief difficulty was in getting a coarser bead of resin which was efficient. Eventually, this was achieved and two processes began to be developed; a continuous operation involving contact agitators and trommels arranged for counter-current washing and an intermittent system using a series of contactors containing baskets which slowly move up and down in a desanded pulp (generally by counter-current washing) with the provision of gentle agitation. As a section becomes loaded, it is flushed with water, stripped and duly returned to operation. This second semi-continuous operation is the one being used in new plant design.

Papers were also presented to the I.M.D.C. at Stockholm; two papers covered uranium recovery, one by Swenke dealing with leaching techniques and one by Clemmer describing the application of solvent extraction.

The flotation of uranium minerals from the Witwatersrand ore has been discussed by Levin, where only a few mines resort to flotation, when the run of mine ore is too low grade for direct leachings.

Nickel and Ilmenite: The production of nickel in Cuba will be by acid leaching in one instance, and in another case, at Nicaro, where serpentine makes this impossible, the raw ore will be reduced in a Herreshoff furnace to render it soluble in ammonium carbonate, the nickel being precipitated by stripping the ammonia with steam.

Ilmenite is being separated from titaniferous magnetite ore at Otanmaki, Finland, by wet magnetic separation to remove magnetite, followed by flotation of pyrite and, lastly, of ilmenite using tall oil as collector. The use of three stages of hydrocyclones for desliming prior to flotation is particularly interesting, involving the return of the last underflow to the first in order to achieve thorough desliming.

Iron Ores: The use of impact crushers has improved recovery in many cases in Germany owing to the selective crushing action.

The reducing roast using hydrogen and other agents to render hematite magnetic has been discussed by Eketorp who has shown that heat economy is essential and that it is possible to use a rotary recuperative furnace utilizing the outgoing gases to pre-heat the feed.

A considerable amount of work has been done on iron ore flotation, both in Sweden (as previously stated) and in the U.S. Republic's Marquette plant is now producing a concentrate from specular hematite ore after grinding to 64 per cent −200 mesh, and desliming with two-stage cyclones. The underflow from the first stage is densified in spiral classifiers and conditioned. The finer fraction is conditioned for a shorter time as long conditioning tends to float silica. Flotation uses Acintol FA-2 (a refined tall oil) and M.I.C. as frother at a pH value of 7.1. After two-stage cleaning a grade of 62 to 65 per cent Fe is attained.

At other plants petroleum sulphonates are being used as collectors.

The Hilton Mine started production at the end of the year and is estimated to produce 600,000 l.tons of pelletized magnetite concentrate annually using dry cobbing and final wet magnetic separation.

With all iron ore, pelletizing forms an important step and some modifications have been introduced. Hilton Mine uses a balling drum and a vertical shaft furnace.

The Erie process, using a shaft furnace, which is said to have a low fuel consumption, is now available, and has been described by De Vaney*. The combination of down and up draft process developed by Lurgi in Germany has been explained by Kurt Meyer*, and the Allis-Chalmer work described by English and Morgan*.

In the last mentioned system the pellets are dried by hot gases, then pre-heated by downdraft at 1,750 to 1,850°F. using oxidizing gases from the last stage. This converts the magnetite partially to ferric oxide with recrystallation in the solid state forming a new mineral structure. Finally, the maximum strength is developed in a rotary kiln at 2,350°F., approx. It is claimed that the process requires no coal or coke mixed with the concentrate, produces harder pellets, and has a high efficiency owing to the use of good exchange between cooling and the pre-heating.

An excellent summary of developments in pelletizing is to be found in the *Engineering and Mining Journal Mining Guide Book for* 1957 (Na:6A).

Non-Metallic Minerals: In many feldspar plants the standard practice is to employ

*At the A.I.M.E. Annual Meeting.

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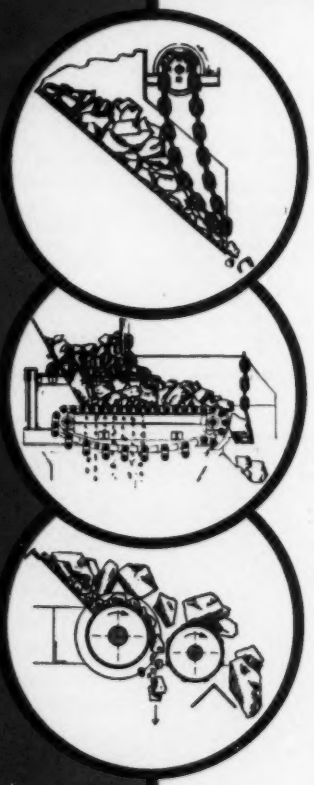

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wet grinding to about 20 mesh, using rod mills in closed circuit with screens, followed by mica removal using flotation after desliming. This is followed by flotation of iron-bearing minerals and finally, the feldspar is floated. Between each stage, removal of reagents in solution by means of cyclones is practised. Such processing frequently yields a low recovery since 25 per cent of the feldspar may be lost in the initial desliming and almost an equal amount in the various tailing products.

At a new plant in the Isle of Man, now producing "Manx stone flux," a mixture of quartz and feldspar, the problem has been partially solved by employing a flowsheet involving screening and treatment of the coarser material by table-flotation. Large flake mica which tends to interfere with grinding, is also removed by table-flotation in the grinding circuit, whilst the fine deslimed sand is treated by normal froth flotation.

In Canada, the Spar-Mica Corporation, which operates extensive pegmatites in Quebec, employs magnetic and electrostatic separation after reduction to 20 mesh, in preference to flotation. The biotite and muscovite, apart from that which is removed by screening, is separated using an Exolon magnetic separator and the feldspar removed from the remaining quartz electrostatically, after pre-heating and using a positive potential of 15,000 to 25,000 volts. It is claimed that this flowsheet has important advantages, including lower operating costs, over the more conventional flotation plants.

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Extraction Metallurgy

By GRAHAM OLDHAM, B.Sc., F.R.I.C., D.L.C., M.Inst.F.

DURING the last fifteen years there have been many changes and many new techniques introduced into the field of extraction metallurgy. The growing atomic energy industry has created an increasing demand for the so-called "rare" metals. In this field we have uranium and thorium used in the fuelling of reactors, together with zirconium and beryllium, the demand for which will certainly rise. Interest has also been focused on other metals which are potentially of great importance, such as titanium. Improvements in the preliminary treatment of ores have effected considerable changes in subsequent extraction processes. A classical example of this is to be seen in the extraction of copper where the use of flotation has had a profound effect on the process. It is inevitable that the newer techniques should, perhaps, attract more than their fair share of attention. This should not be taken to mean that there is little or no progress in more conventional fields. Extraction metallurgy is a highly competitive industry; it can never afford to mark time.

Electrolytic Methods of Production and Refining

A method for the electrorefining of titanium from offgrade sponge and scrap has been described by J. R. Nettle and co-workers.[1] The electrolyte consisted of fused sodium chloride containing 5 per cent titanous chloride, prepared by reducing titanium tetrachloride with sodium. The offgrade metal was used as an anode, pure titanium as the cathode. The current densities used were 5,500 amp./sq. ft. giving a metal with a Brinell hardness of under 80 and 19,000 amp./sq. ft. giving a Brinell hardness of under 100. The metal contaminants, which consisted of oxygen, nitrogen, hydrogen, iron and chloride, remained in the anode sludge whilst enough heat was generated by the current to maintain the electrolyte in a molten condition.

Titanium sponge, made by the magnesium reduction of titanium tetrachloride, is generally contaminated with magnesium and magnesium chloride. The magnesium chloride is normally dissolved out with water and the magnesium leached out with acid, but trouble is often caused subsequently by spattering of the metal during arc melting. A better, electrolytic method of purification has been claimed by G. R. Couch and W. E. Mooz of the National Lead Co.[2] The impure titanium is placed in contact with a carbon anode in an electrolytic cell containing dilute hydrochloric acid as the electrolyte and magnesium is removed by electrolysis.

An electrolytic method of production of titanium has been claimed by G. E. Snow and A. T. McCord of the New Jersey Zinc Co.[3] Titanium tetrachloride is electrolyzed in a fused salt bath. The purity of the metal produced varies between 99 per cent and 100 per cent but the final product contains, on an average, about 0.22 per cent of metallic impurities.

Factors affecting the electrolytic refining of gold have been investigated by J. Steiner and O. Adlhart.[4] The authors studied the effect of using different electrolyte compositions and also used rectified current of various wave forms. They also considered the relation between palladium separation, the current distribution, the cathode potential and the thickness of the deposit. Using pure D.C. a better palladium recovery was obtained than with rectified current.

During the year a number of patents covering the electrodeposition of uranium have been claimed by the American Atomic Energy Commission. In one[5] uranium tetrafluoride is electrolyzed at 800 deg. C. in a fused calcium chloride/sodium chloride electrolyte whilst in another,[6] uranium trichloride is electrolysed in a fused chloride bath containing barium, sodium and potassium chlorides. Electrolysis is carried out at 650 deg. C. using a tungsten cathode, a graphite anode and a hydrogen gas blanket. The uranium recovery is 97 per cent at a 95 per cent current efficiency.

Cyanidation Processes

The Phoenix Prince cyanide plant has been described by P. Rabone.[7] The ore, which is obtained near Bindura in Southern Rhodesia, consists of ancient schists and greenstones intruded by diorite-type granites which contain the gold to the extent of about 2.8 dwt. per s.ton. The plant deals with about 350 tons per day but owing to the presence of a small amount of copper there is a high cyanide consumption. The amalgamation process has been resorted to in order to overcome some of the difficulties encountered in the extraction.

Slimes from cyanide plants treating South African gold ores have been found to contain small amounts of uranium and W. Q. Hull and E. T. Pinkey of the Anglo American Corporation of South Africa Ltd. have described[8] the method by means of which 4,000 tons per day of current and reclaimed slimes are treated at Daggafontein. The slimes are treated with 50 lb. of sulphuric acid and 12 lb. of manganese dioxide per ton and filtered. The uranium is recovered by ion exchange, being eluted with an ammonium nitrate-nitric acid eluant and subsequently precipitated with ammonia. Pyrite is recovered for sulphuric acid manufacture from the leached slimes and manganese is recovered from the ion exchange unit effluent.

Hydrometallurgical Processes

The principles underlying the application of high temperature and high pressure hydrometallurgical techniques have been reviewed by F. A. Forward and J. Halpern.[9] Metals such as gold, platinum, iridium, palladium and rhodium, normally insoluble in hydrochloric acid, may, in fact, be dissolved at high temperatures and high oxygen pressures. Copper, iron, lead, zinc, nickel and molybdenum sulphides can all be rapidly oxidized by oxygen under pressure at elevated temperatures when digested with aqueous solutions of common acids and alkalis. The authors provide over one hundred references which serve to indicate the importance of the

General view of gold cyanidation plant

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techniques. This importance is further underlined by the commercial exploitation of the method. Nickel, for example, is being produced commercially in Canada by the reduction of ammoniacal nickel sulphate with hydrogen.

Cobalt is being recovered from arsenical concentrates by a pressure leaching method at the Garfield refinery of the Calera Mining Co. and the process has been described by S. J. Mitchell.[10] Briefly it consists of an autooxidation step followed by acid leaching under pressure. After various filtration and purification processes, the cobalt is obtained in ammoniacal solution and reduced with hydrogen under pressure. The metal is finally melted in an electric arc furnace and is produced in granulated form.

Interest in hydrometallurgical methods is reflected in the patent literature, typical being the claim of T. K. Ray and H. G. Bocckino of the Chemical Construction Corporation.[11] This patent covers a hydrometallurgical method for the separation of nickel and cobalt in which an acid solution containing the two metals is reduced with a non-sulphidizing gas at a pressure of 600 lb./sq. in. and a temperature of between 250 deg. F. and 350 deg. F. until the pH is between 1 and 2. Some of the nickel precipitates and is removed, the pH then being adjusted to between 3 and 5 when more nickel precipitates. Substantially pure cobalt may be recovered from the filtrate by careful control of conditions.

The engineering aspects of ion exchange in extractive metallurgy have been discussed by A. M. Gaudin et al.[12] In particular, the use of strong base anion exchange resins for the selective recovery of uranium from sulphate leach liquors is considered. Plant performance data and cost factors are discussed, as well as the influence of major variables on column operation. The authors consider that these methods will be increasingly applied in the production of metals more valuable than copper.

Metal Reduction Processes

An extremely interesting and important example of this type of process is the production of titanium by reduction of the chloride using sodium. Up to a year or two ago it was considered that this process was not a commercial possibility, one of the objections being the difficulty of controlling the extremely vigorous reaction which occurs. Imperial Chemical Industries Ltd. are, in fact, producing sodium - reduced titanium and one method of overcoming this particular objection is the subject of a British patent claimed by one of their workers.[13] In order to consume the excess heat of reaction, part of the sodium is maintained in a state of reflux, condensing on the conical lid of the reaction vessel and returning to the reaction mixture via the vessel walls.

Both titanium and zirconium can be produced by sodium reduction and the process may be carried out by mixing sodium vapour with a stream of the halides of either metal. A difficulty which arises when carrying this out, is that accretions of titanium or zirconium form around the admission nozzle and clog it. This, according to R. S. Hood,[14] may be prevented by interposing a mist of either sodium or the halide between the two streams, which is achieved with the use of a special injection nozzle.

A method for the production of titanium of greater than 95 per cent purity has been claimed by T. P. Whaley.[15] Titania, admixed with a calcium halide at 800-900 deg. C., is reduced with sodium, present in 160 per cent excess. The reaction mixture is cooled down after 30 minutes and soluble materials are leached out. X-ray diffraction analysis of the product demonstrates the absence of calcium titanate impurity.

P. P. Alexander has claimed a method for the production of calcium by reducing anhydrous calcium chloride with sodium in an inert atmosphere at a temperature above 420 deg. C.[16]. The resulting mixture of calcium and sodium chloride is extracted with glycerol or liquid ammonia at —28 deg. C. to —33 deg. C., thus removing the sodium chloride. Alternatively the reaction can be carried out in an inert powder which is freely stirrable at the reaction temperature. The most suitable powder for this purpose consists of a mixture of sodium chloride and calcium hydride and the reaction is carried out in an atmosphere of hydrogen.

Other metal reduction processes of interest include a method for the production of zirconium and hafnium by reduction of their tetrafluorides with calcium, described by O. N. Carlson et al.[17], and a method for the production of uranium by reduction of the tetrafluoride with magnesium claimed by D. Peterson of the United States Atomic Energy Commission.[18]

Fluidized Bed Techniques

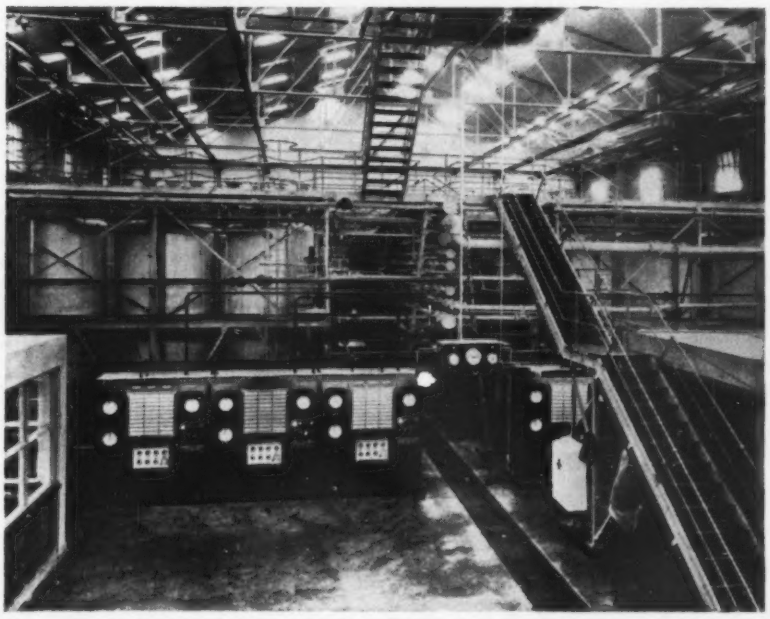
Another technique which has become of considerable importance in the field of extraction metallurgy in recent years is fluidized bed roasting. The economics of the process when applied to the roasting of zinc concentrates have been investigated by S. I. Azos and R. L. Veller.[19] A comparison of the fluidized bed roasting of zinc sulphide concentrates with roasting in rotary bottom furnaces is made. The yield of cadmium and zinc is increased by 1 per cent and 1.5 per cent respectively, and the sulphur dioxide content of the gases is 6-8 per cent compared with 3.8 per cent. In addition, no extraneous fuel is required for roasting. A further paper in the same journal[20] deals in detail with the automation of the process.

The conversion of a multiple-hearth furnace into a fluidized-bed furnace has been described by V. E. Lunev and V. I. Chuprikov.[21] The furnace was used for the roasting of zinc concentrates and it was found that the roasting was very sensitive to variations in conditions. Strict control had to be exercized over the feed size and chemical composition. The paper contains comparative production data for both the original and the modified furnace.

E. S. Howell and co-workers of the Bagdad Copper Corporation have described the method employed in the fluidized roasting of copper sulphide concentrates. Copper sulphate is produced, and this is leached out with sulphuric acid and electrolyzed to yield cathodes containing 99.92 per cent copper with a recovery of 89 per cent. The stripped solution, containing sulphuric acid and a small amount of copper, is diluted with water and used to leach copper from the oxide ore on the dumps.

Ion Exchange Methods

The use of ion exchange methods in the extraction of uranium has already been mentioned. The subject is of considerable importance and D. E. R. Ayres and R. J. Westwood[22] have described



Ion Exchange plant used in uranium extraction

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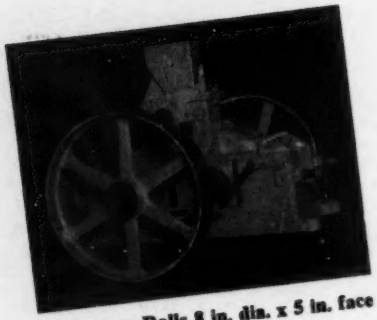
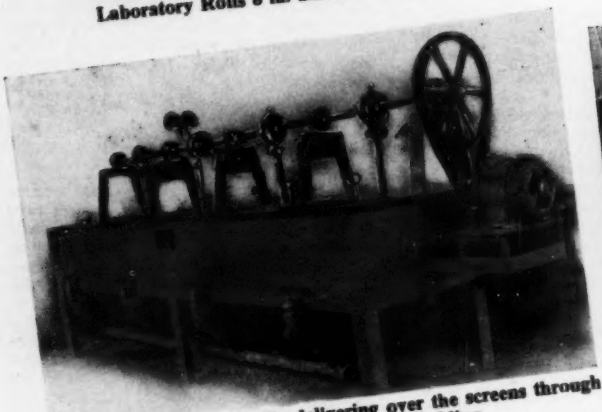


Laboratory Rolls 8 in. dia. x 5 in. face



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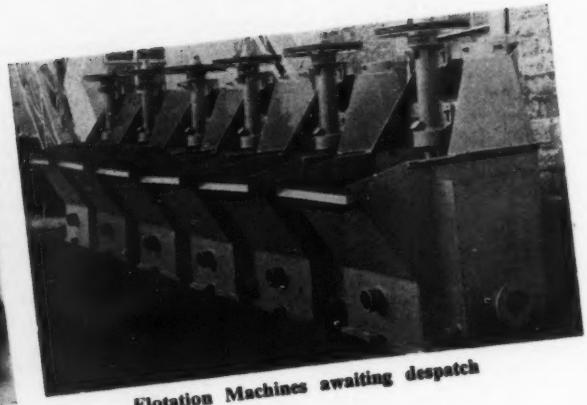

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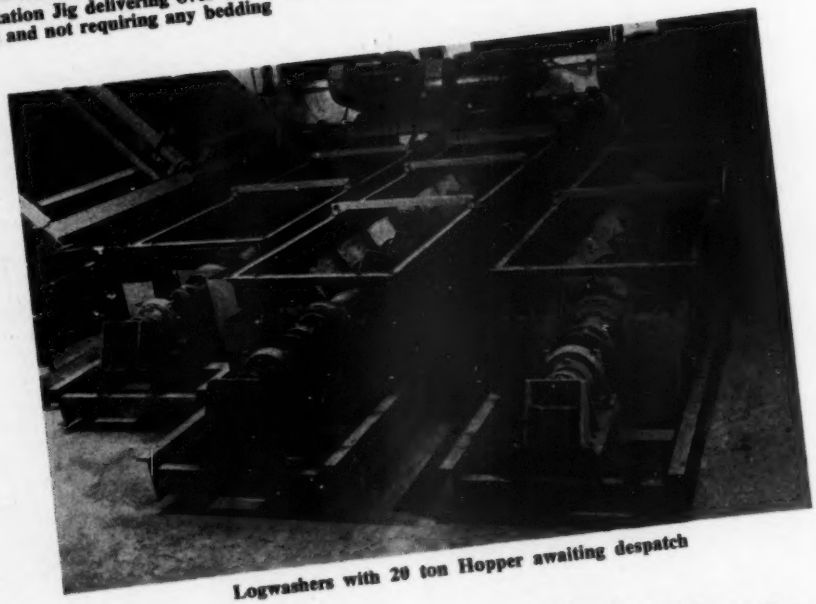

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the use of the ion exchange process in the extraction of uranium from the Rand ores. The uranium is absorbed as the anionic sulphate complex and eluted with an ammonium nitrate-nitric acid solution. The plant consists of a number of sets of three columns, each 7 ft. in diameter, 12 ft. high and containing 200 cu. ft. of resin. The flow rate through each column is 65 gall./min. at a pressure of 60 lb./sq. in. and the column loading at saturation is 3 lb. of of U_3O_8 per cu. ft. of resin. Lime is added to the eluate to remove iron and calcium sulphate, followed by precipitation with ammonia. After calcining, this precipitate assays 83 per cent U_3O_8.

There are, in South Africa, a number of gold producing companies who have made joint agreements with regard to the treatment of slimes for the extraction of uranium.[23] A typical joint production scheme includes the following goldfields: Afrikander, Babrosco, Ellaton, New Klerksdorp, Gold Estates and Stilfontein. The slimes are sent to a central plant where the uranium is extracted by a continuous single-stage leach, followed by filtration and ion exchange. The contributions from each plant are carefully assessed and each company receives a share of the output in proportion to its input. Each company may then sell its output as an individual producer, having regard to its own economic position.

Uranium recovery by an ion-exchange contactor at Grand Junction has been described by I. R. Higgins and co-workers.[24] A batch of ore amounting to 180 tons, obtained from the Rio de Oro deposit in Northern New Mexico, had about 85 per cent of the solids removed in a preliminary sand-slime separation and was then processed in a 12 in. diameter Higgins continuous ion exchange contactor. The resin used was 10-20 mesh Permutit SKB and the feed varied between 7 and 10 galls/min. Uranium losses were quite small and the quality of the final product was found to be reasonably good.

Solvent Extraction Methods

The solvent extraction of slurries is a method also practised in the production of reactor grade uranium and has been described by D. S. Arnold and B. G. Ryle of the National Lead Co.[25] The uranium ore concentrate is digested with nitric acid and the uranyl nitrate solvent extracted. The authors report on the difficulties which are encountered in refinery operations. These include the corrosion produced by the presence of halides in the nitric acid liquors, and scale deposition in the processing equipment. In addition, there is a considerable loss of solvent in the raffinate stream and the pumping and metering of digest slurries with a high solids content also presents difficulties.

A pilot-plant separation of hafnium from zirconium has been the subject of a paper by R. P. Cox.[26] Zircon sand is treated with fused caustic soda and then washed with water. The residue, on treatment with sulphuric acid, yields the sulphate which is soluble and is separated by filtration. Zirconium hydroxide is precipitated, washed, dried and dissolved in nitric acid. The zirconium is solvent extracted from this solution with tributyl phosphate diluted with heptane. The extract, containing less than 100 ppm of hafnium, is stripped with sulphuric acid and the zirconium is precipitated with caustic soda. It is converted to the tetrachloride via the oxide and reduced to the metal with magnesium. Alternatively the zirconium sulphate may be converted to the fluoride and reduced with calcium.

Although not strictly a solvent extraction process, a method whereby a high purity molybdenum powder is produced by treatment with a water soluble polar organic compound is claimed by J. C. R. Kelly and A. G. Caterson.[27] The treatment with, for example, acetic acid may be applied to molybdenum oxide before reduction with hydrogen, or to the metal powder itself prior to vacuum sintering. About 2 c.c. of acetic acid is required per kg. of metal and a metal is produced which has improved physical properties.

Electric Smelting

A British patent has been claimed[28] covering the production of zinc from zinc sulphide in the electric furnace. A mixture of finely ground zinc oxide and zinc sulphide is compressed into tablets and charged into a furnace, preheated to 1,500 deg. C., at such a rate that the temperature does not drop below 1,400 deg. C. This operation takes about 30 mins. and the temperature is then raised to 1,500 deg. C. for a further 17 mins. The issuing gas is cooled by a current of nitrogen and the zinc thus obtained amounts to 95 per cent of the metal in the charge.

The Allard Lake titanium deposit is now being exploited by the Quebec Iron and Titanium Corporation.[29] The ore is smelted in an electric furnace with coal or coke as a reductant and a titania-rich slag obtained. Three phase 250 k.v.-amp open top furnaces are used and a variety of methods of working have been tried. Slags averaging 82.5 per cent titania have been produced by the use of this method.

The electric smelting of serpentine and laterite nickel ores has been investigated by workers of the United States Bureau of Mines.[30] The ore samples were smelted in an arc furnace using bagasse or a mixture of bagasse and coke as reductants. Most of the ores were calcined before smelting since this reduced electrode consumption and improved the furnace operation. By the use of selective reduction techniques it was possible to separate both nickel and cobalt.

Chlorination Processes

Work by V. A. Nieberlein[31] has shown that titanium, iron and niobium can be recovered separately from marginal niobium-bearing titanium deposits using a low temperature chlorination process. Chlorination was carried out in the 400-500 deg. C. range on brookite, rutile and ilmenite sinters with recoveries of 97, 83 and 87 per cent for titanium and 85, 50 and 87 per cent for niobium.

The chloridized roasting of silver has been investigated by A. I. Zazubin and B. N. Lebedev.[32] The silver was mixed with sodium chloride alone and with mixtures of sodium chloride with the sulphate, sulphide or chloride of other metals, notably iron, copper or zinc. The reaction mixture was heated for two hours at 1,000 deg. C. in a current of air. The volatilization of silver was found to increase rapidly above 700 deg. C. and the process was improved by the addition of sulphates which decomposed between 550 and 850 deg. C. This was attributed to the fact that chlorine is produced by the reaction of the sodium chloride with the products of decomposition of the sulphates.

A method for the extraction of germanium from flue dust has been claimed by J. Memel.[33] The dust is treated with hydrofluoric acid to volatilize the silica and the residue is treated with hydrochloric acid in a stream of chlorine when germanium tetrachloride is formed and distilled off. The metal is then obtained by the use of conventional methods.

Miscellaneous Techniques

The zone method of refining, which has been reported in previous reviews, has been applied to the purification of copper by E. D. Tolmie and D. A. Robins.[34] The copper contained 0.01 per cent by weight of antimony, chromium, copper, iron, manganese, nickel, silicon, silver and tin and the distribution of the elements was followed throughout by spectrographic analysis. The rate of zone travel was 11 mm/hour and all the elements with the exception of iron, cobalt and nickel segregated in the direction of travel. These three metals segregated in the reverse direction.

The cyclone method of smelting copper-zinc concentrates has been investigated by A. V. Tonkonogii and co-workers.[35] It was found that the method was more economical than that using the reverberatory furnace and the processes of roasting, melting and distilling could all be conveniently carried out.

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By Our Own Correspondent

ONCE again mining activities in the Union of South Africa set up new record earnings during the past year. For 1957 the total value was £352,898,523 compared with £323,500,000 in 1956, £291,000,000 in 1955 and £247,500,000 in 1954. This figure would have been still higher had it not been for the falling off in prices of certain metals and minerals—notably copper—in the latter part of 1957, which has continued into the current year.

The bulk of the increase again stemmed from the steady climb in the production of gold and uranium, which has by no means reached its peak. The final figure for all gold production, taking in mines which are not members of the Chamber of Mines, was 17,031,690 oz. valued at £212,596,791, compared with 15,896,693 oz. valued at £198,499,603 for 1956. Uranium production was 11,398,214 lb. compared with 8,726,308. The value of exports of "prescribed materials," which includes thorium from Van Rhynsdorp, was £49,859,496 against £38,571,686.

Among the base minerals manganese had a good year, the value of the output being over £1,000,000 up at £5,230,000. Chrome and asbestos yielded £3,612,000 (£2,985,000) and £9,566,000 (£7,686,000) respectively. As was to be expected, copper registered a sharp drop from £13,241,000 to £10,042,000. For most of the year, platinum did remarkably well until the sudden collapse in the world market in the third quarter of the year. The country can be most grateful for the buoyancy of the mining industry, for without it the position of the economy could be difficult.

The import-export gap has widened very appreciably. For 1957 it was £101,500,000 against £82,600,000 a year earlier (excluding movements of gold). Since the end of the year it has been at a higher rate, partly through declines in the value of exports—the wool cheque for the first seven months of the season being £12,500,000 below that of a year ago—but mainly due to the virtual suspension of import control which has resulted in a major spending spree by importers of all types of goods.

GOLD MINING INDUSTRY

In last year's review it was stated that, though 1956 had been a record year for mining, this could not be interpreted as meaning that there were no problems being faced by the mining industry—there were the two major ones of costs and labour. These still exist, but on balance they are not now pressing quite so hard as formerly. It would seem that, at long last, the rising spiral of costs has been checked. Costs of mining supplies and equipment have not shown any material change, but the rate of increase has certainly been appreciably less. This is most marked on the capital equipment side, developing and expanding mines now being able to operate well within the original estimates, whereas not long ago prices moved against them steadily.

Improved Labour Position

The main factors in the improved cost position are the better supply of labour and the better use being made of labour supplies. In past reviews reference was made to the inability of the gold mining industry to compete against secondary industry in the labour market. The slowing down of activity during 1957 and the current year in certain sectors of the economy not only reduced the demand for labour by other industries but has also brought about some measure of retrenchment.

In addition, the supply position has been assisted by the cessation of operations at one or two old mines and the contraction of operations at others. To this must be added the firm control on recruitment by most marginal mines, where very careful consideration is given to filling vacancies caused by retirements or normal wastage. At the time of writing there is a limited re-migration of miners from the Copperbelt, as a result of the suspension of operations at the Bancroft mine, but it is not of major dimensions. The reduction of the scale of operations at Rustenburg Platinum has also increased the supply slightly. Another factor in the labour situation has been an increase in the supply of artisans. The shortage of these played a major part in the output troubles of the gold mines, since it prevented the optimum results being obtained from mechanization and mechanical devices due to maintenance troubles. In general it can be said that, for the first time for many years there is no shortage of miners, and mine managers are being able to become slightly selective in taking men on.

Whether a further slowing down in the country's economic activity will come about and increase the number of would-be mine-workers remains to be seen, but the demand should keep up with any further increase in supply, having regard to the new mines under development plus the requirements of expanding mines.

For the longer term the position is still difficult, the intake of the Government Miners' Training Schools, from immigrants and Union Nationals, being well below the requirements of the mining industry.

What may well prove of more importance than the actual quantitative improvement in labour is the growing adoption in the mining industry of cost control and the putting into practice of the lessons derived from it. In the past year several mines have employed consultants to work out systems for them and the results obtained have been most significant, particularly in the case of marginal mines.

How the system works is shown by a highly simplified example from Rand Leases, which is undoubtedly in the marginal class. Stope "A" gives a net contribution of £2,332 a month and needs 23 Africans to work it. The net contribution per African shift is thus £3 9s. Stope "B" contributes £1,591 using 12 Africans, giving an African shift figure of £5 1s.

When African labour is plentiful both stopes can be worked, but in times of shortage, it becomes clear that it is more profitable to stop Stope "A" and maintain labour strength in Stope "B." It is thus possible from costing information to determine the optimum of deployment of labour not only in stoping itself, but also in stope reclamation and sweeping.

All the indications are that costing and budgetary control will increase rapidly. In itself it cannot save marginal producers or increase efficiency on other properties, but it does enable the best to be got out of available resources—mineral and manpower.

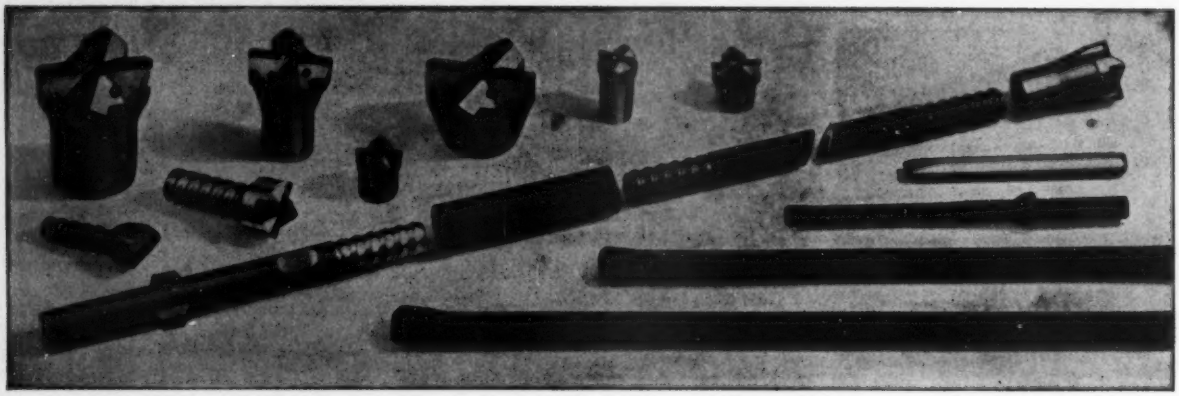
Marginal Mines

It can be said that the position of the marginal mines is somewhat better than a year ago, but it is not an easy one. The prospects for a higher gold price are brighter, but margins of profits are still too thin—16 out of the 54 producers belonging to the Chamber of Mines are operating on one of less than 5s. per ton milled.

The joint committee on the future of these mines has reported to the Government, but at the time of writing its views have not been revealed. Nevertheless, it was considered that the main points were: concession in rail transport rates; reduction in labour force; and non-placement of learners. Whether the committee advocates the assumption by the State of terminal pneumoconiosis liability is not known, but this would be a major boon to old mines.

Shortage of Capital

Although in recent months the market in gold shares has been better and the general view is that the long bear market is now over, the capital position for mining projects is still quite difficult. Risk capital is in short supply, as was reflected in the poor response by the public to the F.S. Geduld issue a few months back and the cancellation temporarily of the F.S. Saaiplaas second share issue. It is becoming more and more apparent that, unless a major boom develops



SANDVIK COROMANT—

A Complete Range of Drill Steel Equipment

You know as well as we do the advantages of buying all your drilling equipment from one supplier. These advantages become still more evident if you buy from the Sandvik Range. The Sandvik Steel Works are the world's largest manufacturers of tungsten carbide for rock drilling. Their production covers integral steels, detachable bits, extension steels and stone working tools—all made of high-quality Swedish alloy steel, all fitted with the well-known Coromant tungsten carbide inserts.

Integral steels with 50% longer life

Sandvik Coromant integral steels have up to 50% longer rod life than ordinary steels, thanks to anti-corrosion SR-treatment, which protects them during transport, storage and actual drilling. In addition, air-tight plastic caps give bit and shank extra protection during transport and storage. They are available in these standard sizes:—

$\frac{7}{8}$″ hollow hexagon	1′4″-13′1″
$\frac{7}{8}$″ hollow hexagon	1′4″-21′0″
1″ hollow hexagon	2′6″-21′0″
Flexible drill steels	2′7″-31′6″

Precision-made rock bits

The threads of Sandvik Coromant (cross and X-design) bits are precision milled. The bits are so accurately manufactured that not only smoother drilling but *longer life* are ensured. Standard bit diameter sizes range from $1\frac{1}{2}$″ to $4\frac{1}{2}$″. The 773 bits (bottoming type) are available with GD400 and GD600 thread, or with $1\frac{1}{4}$″, $1\frac{1}{2}$″ and 2″ rope thread. The 776 bits, for standard shoulder-type drill rods, are available with threads ranging from $\frac{7}{8}$″ to $1\frac{11}{16}$″.

Efficient extension steels

The rope-threaded joints of Sandvik Coromant extension steels are solid and make joining and unscrewing extremely easy. Sizes available: $\frac{7}{8}$″ and 1″ hexagon steels, $1\frac{1}{4}$″ and 2″ round steels. A special feature of the $1\frac{1}{4}$″ equipment is the $\frac{1}{2}$″ flushing hole, about twice as large as most. This gives better cleaning of the bore hole and a higher rate of advance, reduces wear and risk of steels sticking. The 'cold rolling' technique makes this wider flushing hole possible *without any loss of strength.*

Wide variety of Stone Working Tools

A single plug hole steel made by Sandvik is capable of drilling up to 1000 holes, each about 3.9″. Sandvik Chisel Steels are made with rubber sleeves to reduce vibration and protect the worker. Sizes available: Plug Hole Drill Steels with bit diameters ranging from approx. $\frac{31}{32}$″ to $\frac{7}{8}$″. Chisel steels with bit diameters from approx. $\frac{5}{16}$″ to $\frac{25}{32}$″.

The World's foremost drilling unit

Sandvik Coromant extension and drill steels have been developed in close co-operation with Atlas Copco, manufacturers of rock drills and other compressed air equipment. The combination of Sandvik steels and Atlas Copco rock drills is the world's most widely used drilling unit—responsible for the drilling of more than one thousand million feet each year!

The Sandvik Coromant accessories featured here are sold and serviced throughout the world by the Atlas Copco Group of Companies. We have mentioned only the most important products and sizes: for further details, please contact your local Atlas Copco Company or Agent, or write to Atlas Copco AB, Stockholm 1, Sweden.

Atlas Copco *Manufacturers of Stationary and Portable Compressors, Rock-drilling equipment, Loaders, Pneumatic tools and Paint-spraying equipment.*

through an increase in the gold price, the mining industry must find more and more of its funds internally from holding companies and by the issue of debentures and loan stock of various kinds. In the long run this has the effect of mines having very modest capitals in the form of ordinary shares when full production is reached, but it does have a restraining influence on dividend distributions of holding companies.

The major capital-raising undertaking of 1957 was that for the initial financing of Western Deep Levels, the ultra-deep gold mining project south of Blyvoor and West Driefontein on the West Wits line. Until almost the middle of the year it seemed as if this project had been put into cold storage or that the area would be worked by extensions from existing mines. One of the last acts in Sir Ernest Oppenheimer's active financial career was to persuade the other mining houses that the scheme should be pushed ahead.

An involved scheme was worked out which during the course of its operation raised some £20,000,000 which was sufficient to bring the mine to its first stage of operations—the most expensive gold mine in history! With a reef strike of some seven miles Western Deep Levels is estimated to have a life of 60 years, against that of 40 for other mines. The area is underlain by the Ventersdorp Contact reef with an average borehole value of 250 in.-dwt. between 5,000 and 10,000 ft. and the Carbon Leader averaging 850 in.-dwt. between 7,500 ft. and 12,500 ft.

Production from the Ventersdorp reef is estimated to start in about six years time; from the Carbon Leader in nine years and the ultra-deep portion in 18 years. The initial milling rate will be 100,000 tons a month increasing to 200,000 tons. On the present price the total gold content is worth about £800,000,000 and when the mine is in full production recovery will be about 120,000 oz. a month against the present highest output, West Driefontein's, just over 72,000 oz.

Since Sir Ernest started the precementation drills on the shaft sites, extremely rapid progress has been made on the property.

The first stage involves two twin shaft systems—each a 26 ft. diameter hoisting shaft and a 20 ft. diameter ventilation shaft —and these are well on their way. The two systems are some 8,500 ft. apart, with an ultimate depth of 6,000 ft. from where 24 ft. diameter hoisting and 18 ft. ventilation subverticals will be put down. Two similar systems at the eastern and western ends of the lease are planned and eventually for the third stage tertiary systems will be sunk. The headframes are the now usual concrete structures. In full-scale sinking 80 ft. seven-deck Galloway stages are being used. The bottom two platforms can be moved independently. These carry the mechanical cleaning equipment, the upper ones are for concreting and equipping.

Shaft Sinking

The shaft-sinking event of the year was the setting up of a new world record of 834 ft. in 30 days in the No. 2 shaft at Free State Saaiplaas, beating the former record of 763 ft. in the Monarch shaft of West Rand Cons. set up in 1955. This performance settled all arguments as to what should be taken into account in a record, for the shaft at F.S. Saaiplaas has an internal diameter of 27 ft. 6 in., the largest in Southern Africa and possibly in the world. In the course of the run 51,900 tons of rock were excavated. There were significant variations in the equipment and methods used in standard sinking operations at this mine, the record being due to increased experience and first-class team work.

An interesting shaft is being put down at Riebeeck G.M., which is also in the Free State. In this area the mineralization occurs more in the nature of a major orebody than in the usual reef formation. In consequence the shaft is being put down well away from the orebody. It is 26 ft. in diameter and a brattice wall is being installed as sinking proceeds, which will provide both upcast and downcast ventilation. The second entry required under the Mines and Works regulations is being provided by a long drive from Loraine G.M. This, too, is being kept well in the footwall, which will also avoid locking up any ore in safety pillars, etc.

So far there have been no sinking rates approaching the F.S. Saaiplaas record of last year, but few shafts are yet in a position to warrant any record-breaking attempts. Given the right conditions, however, it is by no means impossible that the 1,000 ft. in 30 days will be achieved—the mining equivalent of the four-minute-mile.

Coming Producers

By the time that this appears in print Winkelhaak G.M. may have joined the ranks of the producers. This property has a number of unusual features. It is the first mine in the Kinross area which lies some 35 miles east of the present Far East Rand mines, and it seems likely, judging by the results so far, to be the first of a series of new mines. On the financial side, the production stage will be reached with the lowest capital structure of any mine since well back in pre-war days.

Development on reef so far has disclosed values in excess of those in the original drilling programme, so that an eventual recovery grade of 9.0 dwt. is possible. With a milling rate of 150,000 tons a month, this would produce more than 800,000 oz. of gold a year.

A feature of Winkelhaak is the simplicity of its mill. It consists solely of a jaw crusher for oversized rock and four 50-ton tube mills with cyclone classifiers. These mills—produced by Vanderbijl Engineering at Vereeniging—are in successful use at St. Helena and Virginia and yield an exceptionally high duty. The rated capacity is 15,000 tons a month each, but those in use have handled much larger tonnages and something in excess of 20,000 tons is expected.

This high duty is in part due to the development of electronic control of mill feed, based on the approximation of maximum power consumption to maximum efficiency. The controller automatically controls pebble feed. As a result of the simplicity of the mill, the electronic pebble controller, and centralized instrumentation and control, the whole reduction plant will need only 21 Europeans and 40 African helpers to operate it on a 24 hour basis.

There is little doubt that once "Winkels" is under way as a producer, a start will be made with opening up the second mine in the Kinross area. It seems likely that this will be sited to the west of Winkelhaak, towards Leslie.

The next mine after Winkelhaak to start production will be New Consolidated Gold Fields' F.S. Saaiplaas. This should be a relatively rich property, similar to Harmony which it adjoins. This mine also may present some novel features, since it is believed that investigations into the extraction of both gold and uranium by the ion-exchange system are proving most encouraging. Should this come about it will be a revolution in metallurgical practice.

Klerksdorp

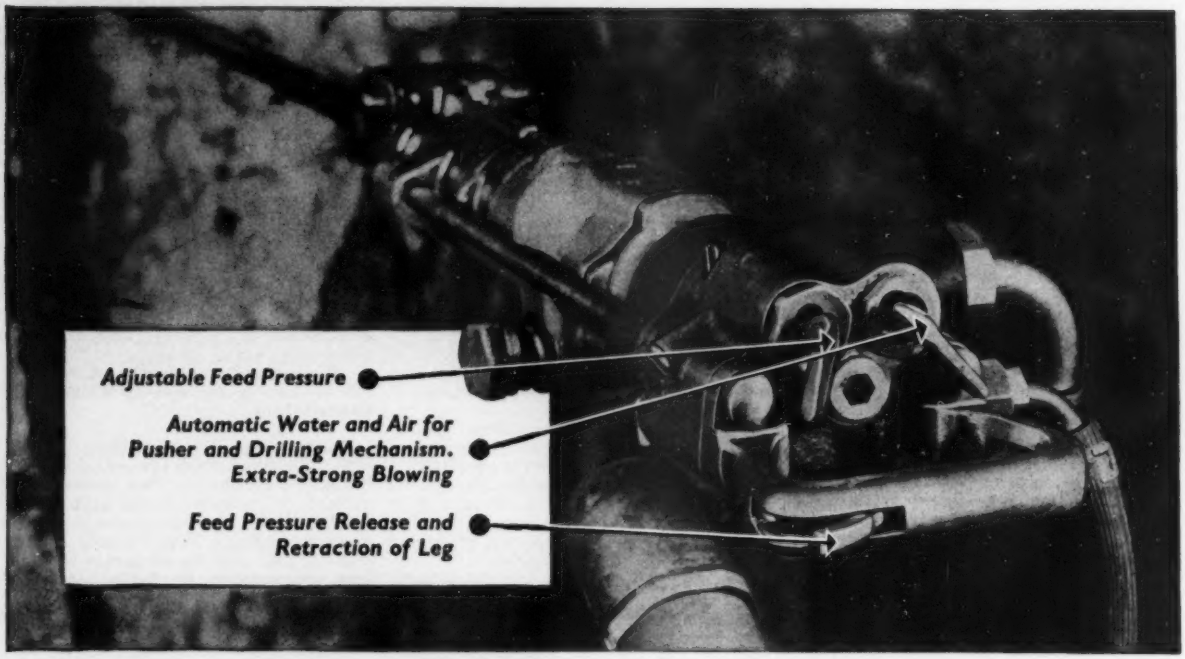
In the Klerksdorp area, Hartebeestfontein G.M. continues to attract considerable interest. Combined profits from gold and uranium have been running at over £550,000 a month with a milling rate of only 85,000 tons a month and a gold ore reserve value of 9.84 dwt. This is largely the result of intensive sorting, which raises the mill grade to 11 dwt. per ton.

An interesting development during the year was the change in the mill circuit to treat the mill product for uranium first and then put it through the gold section. It was found that a certain amount of gold in the ore was coated with uranite, which insulated it from being dissolved by cyanide solution. The changeover has resulted in an additional 2 per cent dissolution of gold. Slime accumulated in the slimes dam before the uranium plant was commissioned is being treated for uranium recovery, most of the old cyanided residue being available for retreatment in the cyanide plant, which now has a capacity to deal with 110,000 tons a month.

THE GOLD INDUSTRY'S PROGRESS

	1955	1956	1957
Tons milled	65,950,700	67,524,700	**66,114,400**
Ounces	*14,093,668	15,373,680	**16,540,817**
Grade (dwt.)	4.274	4.553	**5.000**
Working revenue (gold)	*†£177,414,094	£193,214,230	**£207,705,565**
Working revenue (per ton milled)	53s. 10d.	57s. 3d.	**62s. 10d.**
Working costs	£133,161,104	£144,763,823	**£149,871,972**
Working costs per ton	40s. 5d.	42s. 11d.	**45s. 4d.**
Working costs per oz.	189s. 0d.	188s. 4d.	**181s. 3d.**
Est. total working profit from gold	†£44,252,990	£48,450,407	**£57,833,593**
Est. total working profit per ton from gold	13s. 5d.	14s. 4d.	**17s. 6d.**
Uranium and thorium exports	£29,959,589	£38,571,195	**£49,859,496**
Uranium profits	‡£17,558,208	£24,662,054	**£53,308,195**
Dividends paid	£22,361,887	£28,177,343	**£36,699,373**

* Excludes gold produced by non-members of Chamber of Mines
† Excludes additional revenue: 1954 £12,999; 1955 £233,942; 1956 £882,368.
‡ Subject to adjustment.


Adjustable Feed Pressure
Automatic Water and Air for Pusher and Drilling Mechanism. Extra-Strong Blowing
Feed Pressure Release and Retraction of Leg

THE ATLAS COPCO LION— A REVOLUTIONARY NEW ROCK DRILL

The drill for heavy duty work

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The Atlas Copco Lion is the first drill to have all the valves which operate the drill under the control of one hand. *Full and easy control without having to move the hand from the backhead!* All the controls have been designed so that they are well protected. While using them the operator's hand is never near the wall or roof of the drift. The Lion is the first pusher leg drill with controls placed for drifting.

Retractable leg saves time

When the leg has to be moved the feed pressure is easily released by squeezing the hand grip. By further pressure on the grip the leg retracts automatically. When the leg is in the new position suitable for continuous drilling, retraction stops and the feed pressure comes back by loosening the grip of the hand. *All this can be done while the drill is still running.*

This new idea of a retractable leg enables quicker repositioning of the leg and reduces the number of steel changes, thereby increasing footage per manshift. When drilling high holes it is now far easier to alter the position of the leg more frequently in order to maintain an optimal feed angle and feed pressure.

Packed with power for deep holes

The Lion has a drilling rate at least 30% higher than other rock drills of the same weight. Furthermore, it can maintain its high speed *even when drilling deep holes.* This means quickly drilled deep hole rounds and a faster advance. The Lion also reduces *to a minimum* the gauge wear of the bits in abrasive rock. And owing to the ease with which the feed pressure is released and brought back into action, the Lion is a *handier* drill to work with in fissured rock.

Sandvik Coromant—the steel for the Lion

All Atlas Copco drills—and this goes for the Lion too—have been developed from the earliest stages with Sandvik Coromant tungsten-carbide-tipped integral steels and detachable bits. This combination pioneered tungsten carbide drilling in the early forties. No drill or steel developed separately could ever give such equivalently high performances as this drilling combination. Today it is the most widely used in the world, responsible for drilling more than 1,000 million feet annually.

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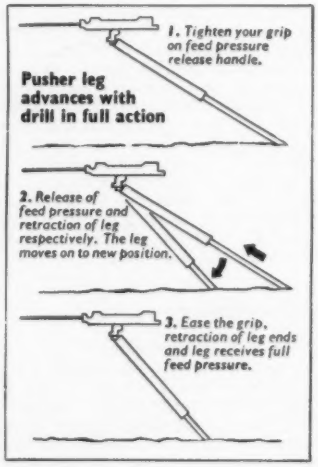
1. Tighten your grip on feed pressure release handle.
Pusher leg advances with drill in full action
2. Release of feed pressure and retraction of leg respectively. The leg moves on to new position.
3. Ease the grip, retraction of leg ends and leg receives full feed pressure.

Atlas Copco

D1574A

Manufacturers of Stationary and Portable Compressors, Rock-Drilling Equipment, Loaders, Pneumatic Tools and Paint-Spraying Equipment

January, 1957, saw the start of gold production at the neighbouring property, Buffelsfontein; in July the uranium plant was commissioned, and after that the sulphuric acid plant. Milling over 100,000 tons a month, this mine has a working profit of more than £330,000 a month.

During the year at Stilfontein G.M. the budgetary and cost control system discussed earlier was introduced and good results are reported. Work is going ahead steadily for the exploitation of the deeper levels of the mine and for increasing mill capacity. Stilfontein was the first mine in the Union to erect a concrete headgear. This is now being modified to take a Koepe winder.

Vaal Reefs has gone ahead steadily, though it has not made such spectacular progress as its neighbours, largely as a result of the depth of the reef. Nevertheless, it is expected that in the current year working profits will keep moving up.

This year may also see a start made with the opening up of the Zandpan lease area, which lies to the west of Hartebeestfontein and north of Vaal Reefs and Western Reefs. This was scheduled to take place last year but was postponed as the result of certain borehole results being suspect. Further drilling has since been done and it would appear that the area is largely underlain by Vaal reef with average values comparable to those ruling in the other properties exploiting this horizon. The depth ranges from 6,000 to 7,500 ft.

The West Wits Line

Apart from the Western Deep project, there has been little change in the West Wits Line picture. In most mines water remains an adverse influence on working costs, since pumping capacity has to be steadily increased. Nevertheless, recent investigations have shown that possibly as much as 30 per cent is being re-cycled owing to the nature of the upper geological formations. It is understood that a scheme is being worked out whereby the water from the mines will be discharged lower down the valley beyond the point from where it can seep back through the dolomites.

Johannesburg Consolidated Investment finished a drilling programme in the area to the east of Venterspost, which defined a compact possible lease area estimated to be underlain by payable reefs of the Upper Elsburg and Ventersdorp Contact reefs containing some 70,000,000 tons of ore probably averaging in excess of 9 dwt. a ton at between 2,650 and 6,500 ft. A decision to go ahead was deferred after consideration of the effects of inflationary trends upon capital expenditure and future estimated working costs.

Central and East Rand

The pressure of costs and the depletion of ore reserves continues to be the major aspect of most of the mines of the Central Rand, and several properties are reducing their scale of operations.

During the past year Government Areas gave a formal notice of its intention to close as a gold producer, thereby provoking a commission of inquiry from which developed the joint committee to investigate the general position of marginal mines. Operations are now on a very limited scale, with the bulk of earnings coming from the recovery of pyrites for the acid plants of the uranium industry.

In view of the failure to find any worthwhile ore in the No. 5 shaft area of Van Dyk and the small likelihood of increasing ore reserves, it was decided to stop all exploratory work, and that shaft pillars should be mined and reclamation work be undertaken. A start has been made with the repayment of capital to shareholders.

The curtailment and suspension of operations by these old mines raises the question of the realization of fixed assets such as headgears, mills, reduction plants and other machinery. The market for this is steadily shrinking.

In the first place, on the new mines concrete headframes are the order of the day and reduction plants are radically different. Compare, for example, Winkelhaak's streamlined mill with, say, the Robinson Deep plant where old stamp batteries are still used. Furthermore, it has been found that in many directions the cost of second-hand material—including dismantling, transport, modification and re-erection—is far more than that of new tailor-made equipment.

The Orange Free State

Once again the Free State is a mixed picture. On the one hand, there has been the steady improvement in reef values at Free State Geduld and—what is probably more important—the strong indications that high mineralization extends over a much greater area than was at first believed, as well as the encouraging results coming up in the northern section of Harmony. On the other is the continuing struggle for existence of Loraine and Freddies Consolidated where

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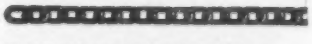

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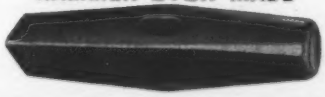

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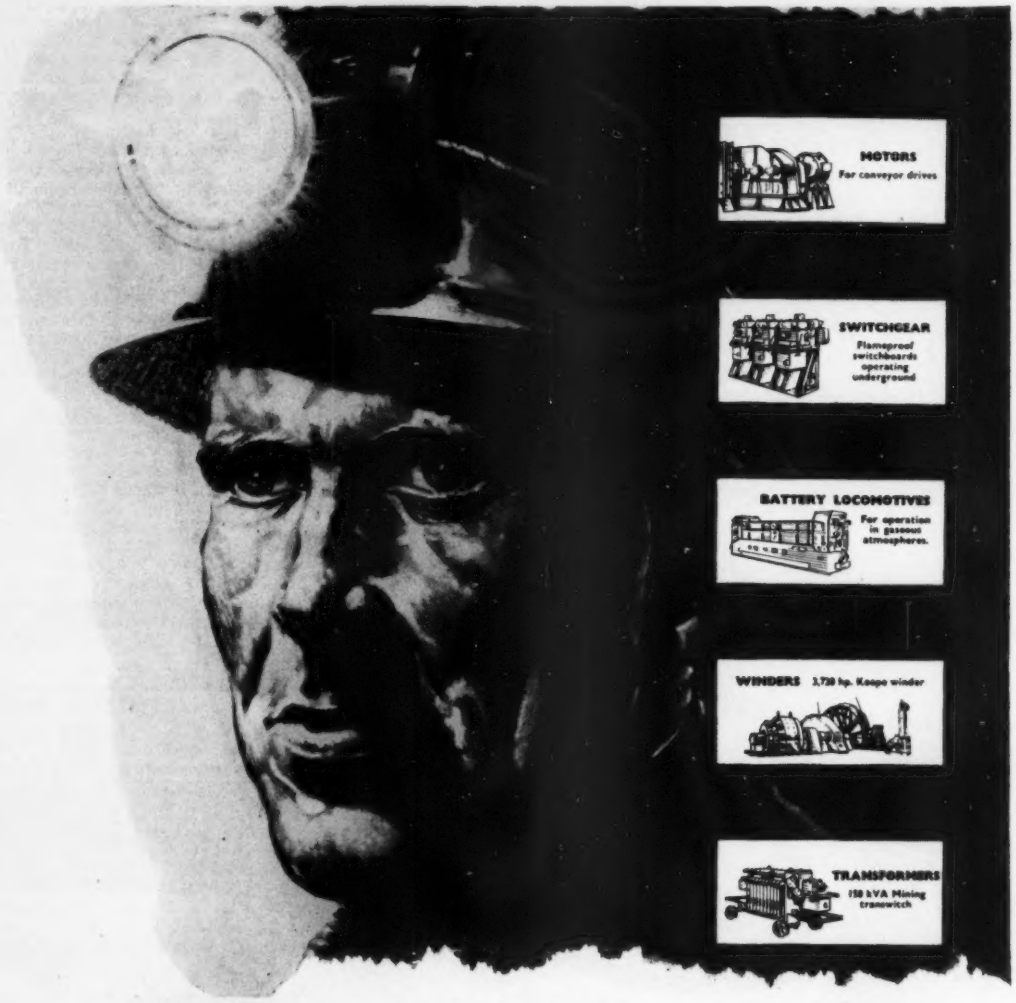

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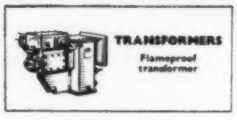

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uranium earnings are providing funds for exploratory development which, unfortunately, so far has not provided any really notable indications.

There is no change in the position at Merriespruit. No pumping or bailing is taking place at this flooded property, since it has been decided that the best method of dewatering would be through a long haulage put through from the neighbouring property Virginia G.M. to a point below the Merriespruit shaft. The water will be drawn off through Virginia's main pumping system, the capacity of which has been increased to 15,000,000 gallons a day.

This is a notable year for shaft-sinking in the Free State, where new ventilation shafts are going down, as well as sub-verticals and at least one new shaft system. These operations are partly in accordance with plans for increasing milling rates and getting into deeper sections of lease areas, and partly to improve ventilation underground where high humidity and temperatures necessitate greater supplies of air.

Water-bearing fissures which have to be cementated continue to give a fair amount of trouble by way of delaying mining operations, but it should be borne in mind that in the Orange Free State field the trouble is caused by static water accumulated over the ages and conditions are not the same as on the West Wits Line, where water drains down from the surface.

The large-scale pumping by all the mines in the O.F.S. is having an appreciable effect on the underground water table. Metering at the flooded Merriespruit shaft has shown a drop of about 100 ft. since the pumping capacities at Harmony and Virginia were substantially increased. It would seem that eventually the whole of this area will be drained of underground water. One suggestion being considered is the use of radioisotopes as a means of tracing the distribution pattern of fissures.

An important advance in the handling of Free State water was taken during the year. Mine water is highly mineralized and in its raw form useless for any purpose. It was not possible to discharge it into natural channels and large dams were built for evaporation purposes. However, as a result of research work by the Anglo American Corporation and the South African Council for Scientific and Industrial Research, an effective and economical method of desalting the water has been developed by means of electrodyalisis—that is by passing the water through a narrow compartment between two membranes, at the same time passing a current at right angles to the membranes.

At the present time a full-scale plant is being built at F.S. Geduld to treat the water from a number of mines. This will deal with some 3,000,000 gallons of water a day. The pure product will be used by the mines. Thus not only will the question of disposal of the brackish water be solved, but the strain on water supplies from the Vaal River will be relieved to some extent.

Exploration

Exploratory work continues into possible new goldfields. General Mining and Anglo-Transvaal are investigating the possibility of the Vaal reef existing in economic values and quantity at workable depth in the area east of Hartebeestfontein and Buffelsfontein towards Potchefstroom. This reef is known to occur immediately across the boundary of these properties but at great depth. The question is whether upthrow faults exist which can make mining possible.

A limited amount of work has been done south of the Vaal River from Western Reefs and Vaal Reefs, but no results have been published. It is believed that one limited area has possibilities and could be explored by haulages from these two mines.

In the Free State preliminary work was started very recently in the Ladybrand-Clocolan area, which lies on the Basutoland border. The object of this is to determine what lies underneath the Beaufort series. One theory was that the Basal reef of the O.F.S. field might be found, but a more feasible suggestion is that the Witwatersrand series might be found—possibly a continuation of the Kimberley reef now being opened up in the Bethal-Kinross area.

There is also the possibility that the Erfdeel-Dankbaarheid area to the north of Harmony and F.S. Saaiplaas may be redrilled. Rumours of this crop up from time to time. One suggestion is that the Corner House group may move in this, as it is said that Mr. C. W. Engelhard, the new chairman, seeks to increase its mining interests.

Uranium

There is little fresh to report about uranium. The last recovery plant under the Combined Development Agency scheme, that at Buffelsfontein G.M., was commissioned during the year. Afrikander Lease went ahead with its exploratory and development work, obtaining most encouraging values in the Dominion reef series.

At the time of writing a visit was expected from representatives of the Combined Development Agency from the U.K. and America. It is assumed that the likely level of uranium production over the next few years will be discussed. It would appear that this is likely to be in excess of that envisaged when the contracts were originally negotiated—partly through a higher rate of gold mining operations and partly as a result of expansionist plans for certain young mines which will result in more uranium-bearing slimes becoming available for treatment. There is also the question of mines yet to come to production, such as Western Deeps, Zandpan and F.S. Saaiplaas. The last-mentioned could be most interesting as, according to reports, the "U" values are among the best in the O.F.S.

DIAMONDS

A record sales figure for both gem and industrial stones was reported by the Central Selling Organization for 1957. Gems realized £58,818,096 and industrials £23,954,026, making £76,772,112 in all. The figures for the first quarter of this year show a decline of some £2,000,000 in sales of industrial stones compared with the comparable period of last year, but gem sales were only some £400,000 down at just over £10,500,000. According to Johannesburg sources, the demand for first-class stones remains good but these are not in free supply.

On the technical side, the most important development over the past year has been the construction of a new central washing plant at Kimberley. As a result, should it be necessary, three mines can be worked in the area instead of only two as at present.

On the exploratory side, De Beers have been granted prospecting rights over the Kleinzee Annex in Namaqualand. This area lies immediately to the South of Orangemund (Cons. Diamonds of S.W.A.) across the Orange River on the Cape Province side. It forms part of the State Diggings.

PLATINUM

Until September last year it looked as if platinum mining had nothing but a brilliant future ahead of it. The Rustenburg mine had its first stage expansion scheme in operation, resulting in an increase on the 1955 capacity of 50 per cent, and the second stage which would have brought this up to 80 per cent well on the way to completion. Then came the virtual collapse of the world platinum market. Oil refiners cut down on orders, this trend being aggravated by the development of a catalyst needing only 50 per cent of the amount of metal used previously. In addition, Russia resumed exports to the Western World. Work was immediately stopped on the second scheme at Rustenburg, but a further deterioration in both the price and demand necessitated a cutback on the whole level of activity, with the result that operations are currently on a very restricted scale and the company is faced with the need to find funds to meet the capital expenditure on plant and equipment now cocooned pending a recovery in the world platinum market.

BASE METALS

Copper did well for most of 1957, but during the latter part of the year and the first quarter of 1958, producers were hit by the landslide in the metal price. O'Okiep has curtailed production. Messina continued to operate with a satisfactory profit in spite of the decline in the metal price. This undertaking has benefited from the programme to improve operating efficiency adopted over the past 10 years. Cost of production of refined copper is running at £130 per l.ton.

The state of the copper market has resulted in a reduction in the tempo of exploratory work into the large but low-grade deposits in the Eastern Transvaal, in which the Union Government, Rio Tinto, Newmont Mining and Merensky Trust are associated. It certainly does not look as if any decision on the future of this ground will be made for a good while yet. As will be seen from the statistical table, manganese producers had an exceedingly good year, due largely to better rail facilities. In recent years use has been found in the uranium recovery process for low-grade occurences, fortuitously existing in the Western Transvaal, and small operators have benefited.

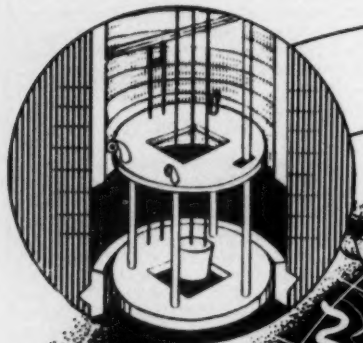
Of major importance to the manganese industry is the ferro-manganese project in Natal sponsored by Anglo-Transvaal Consolidated. Raw materials will comprise iron and manganese ores drawn from Associated Manganese's properties in the Postmasburg district of the Cape Province.

This development fits in with Government policy that wherever possible the

BASE MINERAL OUTPUT

(in s.tons)

	1956	1957
Antimony	15,684	**17,546**
Asbestos.....	136,510	**143,643**
Chrome	649,982	**736,616**
Coal	37,039,706	**38,759,434**
Copper	47,195	**50,839**
Iron ore	2,275,487	**2,293,103**
Manganese.....	717,545	**787,883**



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Union should endeavour to process or semi-process raw materials, rather than export high-grade resources in order to increase earnings.

Initial capital expenditure on the Cato Ridge plant will be about £2,000,000, but a total of £12,000,000 may be spent on it eventually. Initially, the target is 40,000 tons of ferro-manganese annually for the export trade, which will be shipped through the Durban manganese loading plant. Part of the long-term plan is to produce pig iron, both for export and with a view to the possible establishment of steel making and the development of heavy industry in the area.

The chrome figures for last year were most satisfactory, due largely to improved rail transport, but producers are concerned over the trend of the American economy. Already one company has suspended operations in the Rustenburg district and further curtailments are quite possible.

Asbestos has also done well. So far the depressed state of commodity markets has not affected the industry. There have been no new mining developments. Recently, the Government Mining Engineer raised the question of whether steps should not be taken to undertake more processing of fibre in the Union.

Coal

Coal consumption continues to rise steadily, but prospects of large-scale exports seem as remote as ever. The main development has been the formation of a new colliery company to open up deposits in the Witbank area for the sole purpose of feeding a major new electric power station. The new colliery will have reserves of some 30,000,000 tons, while the station's requirements will be around 1,000,000 tons a year.

SOUTH-WEST AFRICA

ON the face of it 1957 was a good year for mineral production in South-West Africa with exports earning not far off £30,000,000. But as in so many other countries, the boom conditions at the start were by no means maintained in the latter part of the year and the start of 1958 saw a further deterioration in the position. This is clearly shown in the official returns for February, 1958, which indicate falling off in outputs and a sharp contraction in exports, particularly in respect of rarer minerals.

The two major undertakings are still Consolidated Diamonds and Tsumeb Corporation. Cons. Diamonds' production continues to run at the satisfactory level of around £1,500,000 a month. Larger earth-moving equipment than ever before is being brought into operation to deal with overburden.

During the year, a concession was granted to a S.W.A. syndicate of the ground between low water and extending some 800 yd. into the Atlantic Ocean from the high water mark in Diamond Areas Nos. 1 and 2 over which Cons. Diamonds claimed exclusive rights. C.D.M. took the matter to the Supreme Court in S.W.A. It upheld the Syndicate's concession. The matter has now gone to the Appelate Division in Bloemfontein.

Other diamond activities continue on a very limited scale. Industrial Diamonds

S.-W. AFRICAN OUTPUT OF PRINCIPAL MINERALS

(in s.tons unless otherwise stated)

	1956	1957
Beryl	454	385.47
Concentrates:		
Lead/Copper/Zinc..	239,259	246,465
Lead/Vanadium ..	4,050	3,512
Lead sulphide	2,910	5,271
Zinc sulphide.....	6,010	15,685
Tin	449	633.39
Tin/Wolfram	649	807.38
Lithium ore	5,645	6,740
Tantalite/Columbite (lb.)	13,433	24,001
Tungsten ore	149.8	44.5
Manganese.....	57,262	89,661
Diamonds (ct.)	987,599	976,328

(S.W.A.) announced the discovery of fresh deposits near Luderitz, but nothing noteworthy has appeared in the official output returns so far. To the far north on the Angola border, J. Levinson is operating, but here also there have been no returns of major significance.

Like most base mineral producers, Tsumeb Corporation has been affected by the deterioration in world commodity prices. During last year, New Consolidated Gold Fields took over the old South-West Africa Co. Early this year, the drop in metal prices resulted in the closing down of the Abenab West lead-vanadium mine. According to reports it is considered highly unlikely that operations will ever be resumed again.

The popular Press carried stories over the past year of spectacular uranium discoveries in the Namib Desert, but there has been no official confirmation. It may well be that there are "U" occurrences in the territory, but it should be remembered that few prospects of most ores have been more than an isolated occurrence of extremely limited tonnages.

Manganese production increased at the Okahandja mines following their coming under the control of Johannesburg Consolidated Investment. The company is, however, still hampered by transport difficulties, though these should be eased once the broad-guage railway line now under construction has been brought into operation.

BECHUANALAND

A GENERAL increase in attention is being paid to this Protectorate's mineral resources, due largely to the efforts of the Geological Survey Department, and also to the fact that Rhodesian Selection Trust are interested in the Bamangwato Reserve potential. To this end Seretse Khama and his advisers proceeded to the U.K. early in this year to make preliminary arrangements.

Production of chrysotile asbestos continued from Moshaneng Mine in the Bangwaketse Reserve in the Southern Protecorate and the output for the calendar year, 1957, was 1,110 s.tons above the figure for 1956. A limited amount of kyanite was produced from the Halfway Kop mine, 10 miles south-east of Francistown in the Tati Concession. Some gold and silver was also produced in this area from small workings similar to those found in the schist belt areas in Southern Rhodesia.

Two small manganese mines were opened in the south-eastern Protectorate during the second half of 1957, following the award of Crown Grants to two mining companies. The one occurrence, which was located by a geologist of this Department, is in the Bangwaketse Reserve and ore occurs as pods and larger lenses in a shale horizon immediately overlying the Black Reef quartzites of the Transvaal System. No export of ore took place from this occurrence during 1957, but active development is in progress. No estimates have been made of probable ore reserves. A limited amount of ore was exported from the Seival occurrence, which is in the Bamalete Reserve. A characteristic feature of both occurrences is that the manganese ore is very low in iron.

The following are the figures for the production of gold, silver, asbestos and manganese ore in the calendar year of 1957:

Gold: 190.49 f.oz. valued at £2,338 4s. 9d.
Silver: 35.36 f.oz. valued at £11 10s. 0d.
Asbestos: 2,466 s.tons value not yet to hand.
Manganese ore: 237 s.tons valued at £2,300.

Mining companies continue to display an active interest in the mineral potentialities of the Protectorate. The major interest was centred on the known mineral occurrences in the Bamangwato Reserve including the Bushman Mine copper deposits some 70 miles north-west of Francistown, the Magogaphate nickel occurrence in the north-eastern Bamangwato Reserve and the potential coalfields areas. Interest was also shown in the evaporite deposits in the Nata area of the Makarikari region.

The Anglo American Corporation of South Africa, as technical advisers to De Beers Consolidated Mines Ltd., continued prospecting operations in the Tuli Block farming areas during 1957. The mineral rights in the Tuli Block are owned by the British South Africa Co.

BASUTOLAND

PROSPECTING for diamonds by the Jack Scott group continues, but it does not seem as if sufficient information has been gained to take any decision on whether exploitation will be undertaken. The investigations into the development of hydro-electric power stations and the consequent control of water supplies are being watched with interest by the Union, since these could prove useful supplies of power and water to the Free State goldfields.

SWAZILAND

PROGRESS is being made towards the exploitation of this country's iron ore and coal deposits. It would appear that the Colonial Development Corporation is likely to undertake this itself rather than grant concessions of private enterprise, as was originally thought. It is understood that consideration is being given to the production of pig iron on the spot rather than exporting ore—provided a suitable smelting process can be operated. The whole scheme is closely tied up with timber and sugar cane growing, and this will largely determine which way the rail link to the sea will be built. The probabilities are that it will be into Natal—to Durban in the first place and in due course to Sordwana Bay, should the Union Government go ahead with the development of the latter.

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SOUTHERN RHODESIA • NORTHERN RHODESIA

NYASALAND

SOUTHERN RHODESIA *By Our Own Correspondent*

A RECORD year of mineral production was again achieved, despite tremendous decreases in metal prices during the latter half of the year. The total value of the mineral output rose in 1957 to £25,764,070 from £23,260,575 in 1956. Asbestos (£9,016,388) was again the most valuable product, followed by gold (£6,663,635) and chrome ore (£4,517,500).

In considering the Colony's mining industry it should be borne in mind that the value shown in respect of each mineral is that at the mine, on which any royalty is levied. It is the selling price, less the cost of transport, railage, dock charges, shipping commission, etc. The true total figure is nearer £50,000,000 than £25,000,000.

Major increases during the year were made in asbestos and chrome.

Exploration

As forecast in the *Mining Journal Annual Review*, 1957, considerable prospecting activity occurred, as evidenced by the following figures:

	1956	1957
Prospecting licences issued ..	5,190	**5,718**
Blocks of claims registered		
Precious metals.....	323	**226**
Precious stones	1	**1**
Base metals	1,847	**2,165**
Blocks of claims current		
Precious metals.....	2,773	**2,512**
Precious stones	1	**1**
Base metals	8,548	**9,738**
Coal.....	14	**14**

The year can be regarded as one of consolidation, on the part of the larger mining houses, and there is a general move to establish headquarters in Salisbury. Rhodesian Selection Trust opened new laboratories and propose a 20-storey building for their offices, which will be by far the city's tallest. New Consolidated Goldfields established their headquarters in the magnificent new Charter House of the British South Africa Co. Rio Tinto are moving up from Johannesburg, in the new year, and Lonrho, who have always been established in Salisbury, propose the erection of a new 15-storey block.

But the smaller mines continue to fade. The Rhodesian Mining Federation, formerly a flourishing association of small mine owners, amalgamated during the year with the Rhodesia Chamber of Mines, which may be regarded as a symptom of the changed conditions.

Uranium

Southern Rhodesia looks like being a non-starter in the atomic minerals race, in spite of considerable efforts made by the U.K. Atomic Energy Authority to stimulate prospecting. The Authority commissioned Hunting Geophysics Ltd. to carry out a scintillometer survey covering a degree square of little known, but likely, country. Maps of the anomalies were sold to the public at nominal price, and though a considerable pegging rush ensued, no worthwhile find has so far materialized.

Asbestos and Chrome

No major change occurred in the asbestos industry. Production rose to 132,124 tons valued at £9,016,388 from 118,972 tons worth £8,524,671 in 1956.

Following the waiving by the Southern Rhodesian Government of royalties on Grade 7 and Grade 6 asbestos, Rhodesian producers are stepping up output of these lower grades in a determined effort to break into new world markets.

Though lower grade varieties proved more difficult to sell, a great spurt in pegging activity took place at the year end. Much deep level ground is known to exist along the centre of the Great Dyke, and it was this portion that attracted the interest of several mining houses not normally associated with chrome mining.

The improved rolling stock position resulted in greatly increased shipments of chrome during 1957. It was hoped that rising production would be reflected by total outputs of about 800,000 tons in 1958 and 1,000,000 tons in 1959. However, the immediate outlook has been clouded by the less favourable market position, as a result of which Rhodesian Vanadium Corporation announced in February, 1958, the temporary cessation of production at its Spots chrome mine between Selukwe and Shabani.

MINERAL OUTPUT
(in 000 tons unless otherwise marked)

	1955	1956	1957
Gold (000 oz.)	524.7	536.4	**536.8**
Silver (000 oz.)	76.8	76.9	**74.2**
Antimony ore	0.4	0.1	**0.1**
Arsenic	0.5	1.1	**0.9**
Asbestos.....	105.3	119.0	**132.1**
Beryllium ore.....	1.0	0.6	**0.6**
Chrome ore	449.2	449.0	**654.1**
Coal raised.....	3653.8	3917.5	**4246.8**
Copper	1.2	1.9	**2.1**
Corundum.....	1.2	4.4	**4.5**
Iron ore	92.8	128.0	**148.8**
Iron pyrites	23.8	20.9	**22.4**
Limestone	663.5	785.5	**834.7**
Lithium Minerals:			
Amblygonite	0.2	0.6	**0.1**
Lepidolite	57.7	84.6	**93.5**
Petalite	24.2	13.5	**9.9**
Spodumene	0.1	4.4	**5.6**
Magnesite	11.6	8.6	**2.9**
Mica block (000 lb.)	141.6	1.2	**70.0**
Tin conc.	0.3	0.6	**0.1**
Tungsten conc.	0.2	0.3	**0.2**
Vermiculite	—	0.3	**0.5**

Copper and Nickel

The Messina Transvaal Development Co. brought its Mangula Mine to production with the starting up of one Aerofall mill unit. Concentrates are being shipped. This company's production from the small Umkondo Mine continues, but it has ceased drilling on its Sanyati Claims, where the ore is a complex of Pb, Zn and Cu.

The closing down to a care and maintenance level of Rio Tinto's much vaunted Empress Nickel Mine in the Ngondoma came as a considerable disappointment to the mining community as a whole. The reasons for suspending development operations were stated to be insufficient reserves proved to date coupled with the necessity for a good copper price.

Lithium and Tantalum

Lithium continues to be a major new export, and it is believed that Rand Mines Ltd. and Billiton Maatschappy are both considering entering this field.

Bikita Minerals have announced that the rate of production of lithium ore is to be reduced as a result of delivery of higher grade ore than was originally planned, at improved overall efficiency, and the build up of the necessary stockpiles to ensure regular supplies.

In a small way considerable interest is being shown in exploration for tantalum which occurs in many of the lithium-bearing pegmatites in the form of microlite. The presence of this mineral is seldom evident in land specimens, and at present prices only a fraction per cent spells payability.

Gold

As base metals decline in value there has been a steady increase in the number of claims pegged for gold, though no new occurrence of any note has come to light.

Precious Stones

A discovery of very good quality emeralds in the Belingwe Reserve has caused international interest. Exploitation is being carefully controlled so as not to effect the limited world market.

Coal

The price of coal in the Federation dropped by an average of 7d. a ton at pit mouth for all the grades and types on November 1, 1957. The past average price was 19s. 6d. and it dropped to 18s. 11d. a ton. The lower price was made possible through cheaper production costs, which, in turn, were caused by greater sales of coal.

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NORTHERN RHODESIA *By a Special Correspondent*

THE past year has not been a happy one for mining in Northern Rhodesia, chiefly because of the sharp fall in the price of copper from £267 a ton at the beginning of 1957 to £182 at the end. Since the end of 1957 the price has, of course, dropped still further. The value of the territory's copper production last year was only £89,000,000, comgrade ore than was originally planned, pared with the record figure of £121,000,000 in 1956.

In an attempt to check the fall, one of the two big Copperbelt mining groups, Rhodesian Selection Trust, cut production at its two main mines—Roan Antelope and Mufulira—by 10 per cent in June. This cutback was achieved without any lay-off of workers. Considerably more serious, however, was the announcement soon after the end of the year that the £18,000,000 Bancroft Mine, owned by the second big Copperbelt mining group (Anglo American Corporation), which was opened only in March last year, would close down from the end of March, 1958, for a period of one year. Anglo American decided to close Bancroft when it fell into line with R.S.T. and other world copper producers in cutting back production by 10 per cent. The group decided that the best way to achieve this cut was to close Bancroft altogether and slightly increase production at its other two Copperbelt mines—Rhokana and Nchanga —rather than to continue to operate all three mines at 90 per cent of capacity. The mine is being maintained on a caretaker basis for a year with a staff of 160 Europeans and 1,000 Africans. The mine formerly employed about 650 Europeans and 4,000 Africans.

Chibuluma completed its first full year of production in 1957. The scheduled production rate of 40,000 tons of ore a month was maintained and overall costs per l.ton of copper were considered satisfactory.

Bancroft has not been the only Northern Rhodesian mine to close down in the past year. On October 31 last year, an underground stream broke into the workings of the £1,000,000 Kansanshi copper mine, which is situated 120 miles west of the Copperbelt near the Belgian Congo border. The underground workings were completely flooded and all work has ceased at the mine. The comparatively small labour force of 63 Europeans and 500 Africans has been re-employed at other mines. Pumping operations have been carried out in an attempt to determine the feasibility of de-watering the mine and metallurgical studies are also being conducted. No decision on the ultimate future of Kansanshi is likely before June, 1958.

The great Kariba hydro-electric project in the Zambesi Valley, on which the Copperbelt is relying for additional power supplies from 1960, suffered a setback when record floods, soon after the end of the year, disrupted work and caused damage unofficially estimated at between £500,000 and £1,000,000.

The copper mines' production costs were considerably increased during the year by the decision of the Rhodesia Railways to more than double their tariff for carrying copper from the Copperbelt to the coast.

Detailed accounts of the year's progress on the mines in the Rhoanglo and R.S.T. groups appear on pages 288-293.

The year was marred by bitter labour disputes. On the credit side, however, relations between the companies and the European Union have shown considerable improvement since the publication of the Honeyman Report, while the moderate leadership of the African Union, headed by its president, Mr. Lawrence Katilungu, scored a signal triumph soon after the end of the year in achieving re-election with a majority from all the Union's seven branches.

Labour

If 1956 was the Copperbelt's most troubled year for African labour, culminating in the declaration by the Government of a state of emergency in the area, 1957 was perhaps the worst year yet for European labour disputes.

During the year, European miners on Copperbelt mines were involved in ten strikes, all of which were later described as unconstitutional by the Honeyman Commission of Enquiry.

This troubled state of affairs came to a head in July when all mines were forced to shut down following a dispute between the companies and the European Union over the hours of work of rockbreakers.

After a shut-down lasting more than a week, at the height of which 5,000 Europeans and 30,000 Africans were idle, the companies and the Union agreed to a proposal put forward by the Government-appointed mediator, Mr. Roy Philpott, Assistant Labour Commissioner to the Northern Rhodesian Government, that a Commission of Enquiry should be appointed to investigate the dispute and make recommendations for the avoidance and quick settlement of disputes in the copper-mining industry. The Union then instructed its members to return to work on August 1.

A five-man Commission of Enquiry was appointed under the chairmanship of Mr. G. G. Honeyman, chairman of the U.K. Industrial Court. Its members included Sir William Lawther, secretary-treasurer of the Miners' International Federation; Judge H. J. Hoffman, a Southern Rhodesian Judge; Mr. E. M. Hyde-Clarke of the British Employers' Federation; and Mr. A. D. Vos, a South African labour expert. It heard evidence during September and October, and published its report and recommendations at the end of October. at which date production was therefore resumed.

The report, which was unanimous, was highly critical of the European Union and commented unfavourably on several of its officials.

The commissioners said they did not like the closed shop principle, but they believed that no useful purpose would be served by recommending its outright abolition by legislation because this could lead to further industrial unrest. However, they thought it equally undesirable that the closed shop should be retained in its present form. They recommended that if the closed shop principle is to be retained, strike action should be permitted only if a two-thirds majority of Union members vote in favour of it in a secret ballot. They also recommended that, if the companies and the Union do not agree to make cumpulsory arbitration part of their agreement within six months of the Northern Rhodesian Government's asking them to do so, the Government should introduce legislation to make arbitration compulsory after conciliation has failed.

As a direct result of the report of the Honeyman Commission, the Northern Rhodesia Government proposed to introduce a Bill at the next session of the Legislative Council which would have the effect of restricting the right of trade unions, especially in regard to strikes and the operation of closed shop agreements. The publication of this Bill brought strong opposition from both the European and African Unions and from a delegation from the International Confederation of Trade Unions which visited Northern Rhodesia early in 1958. It is now considered likely that the Northern Rhodesian Government will not, in fact, proceed with this legislation, or that, if it does so, it will be in a very much modified form.

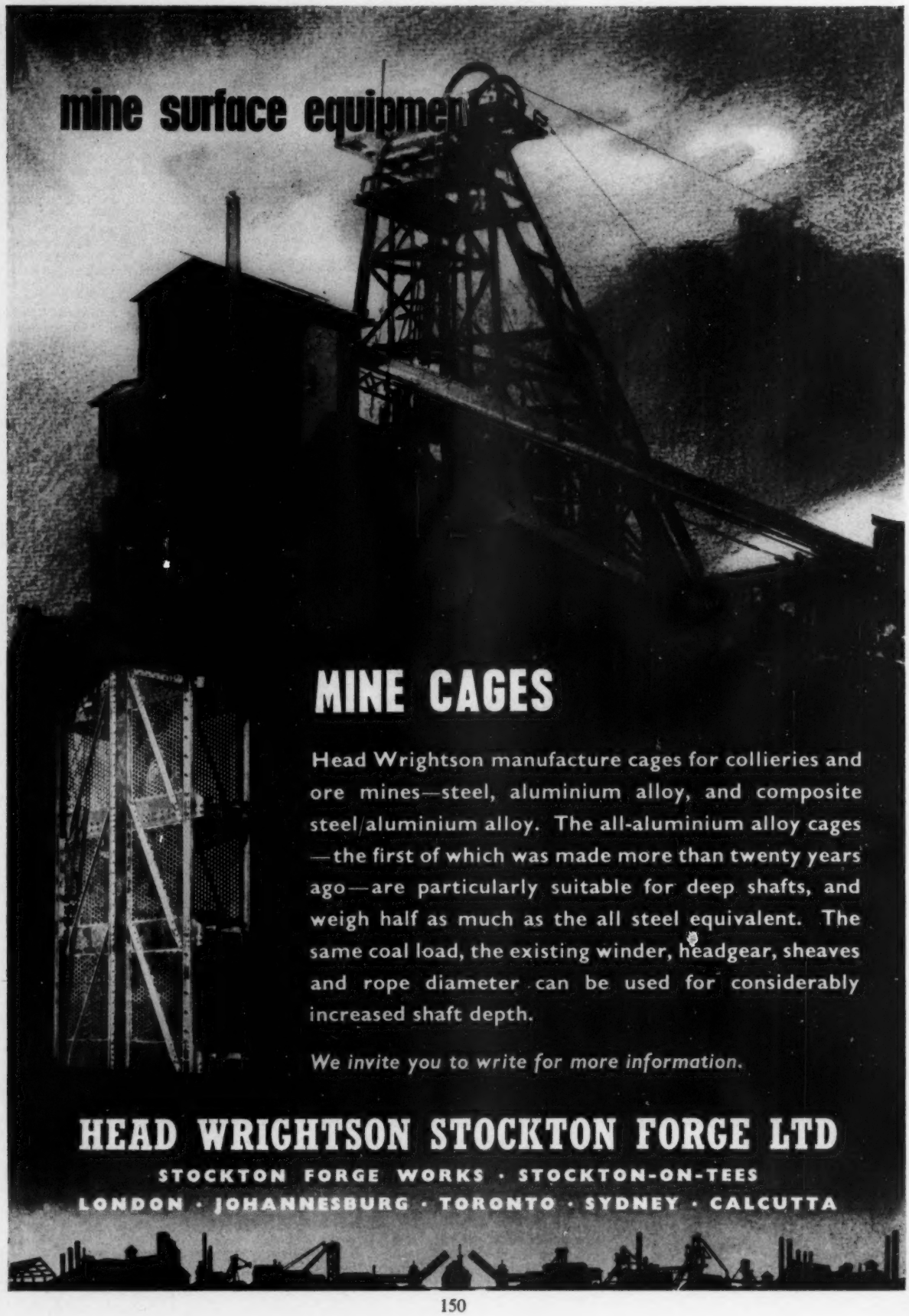
The publication of the Bill has had one result which may be of far-reaching significance to future labour relations in Northern Rhodesia. It has brought together the European Mineworkers' Union and the African Mineworkers' Union, who are making a joint protest to the Federal Prime Minister of Rhodesia and Nyasaland, Sir Roy Welensky, and who also plan to send a joint delegation to the U.K. to agitate against the proposed legislation. This is the first time the European and African Unions have taken joint action on any matter of importance and shows that the European Union's somewhat truculent attitude earlier in the year, when it sought to place obstacles in the way of the advancement of African workers in the copper mines, has been drastically modified.

It shows, too, that the moderate leadership of the African Mineworkers' Union and especially that of its able general president, Mr. Lawrence Katilungu, has triumphed over the opposition elements in the Union, backed by the Northern Rhodesian African National Congress, which sought to overthrow Katilungu and substitute extremist policies for the comparatively moderate ones Mr. Katilungu has long pursued.

During the year, minor disturbances took place in several mine African townships. Northern Rhodesian Government Labour Department officials believe that they were inspired by Congress officials as part of their campaign against Katilungu and his colleagues. However, at the African Union's annual convention, the Katilungu group was returned with a substantial majority from all seven branches of the Union and it now seems certain that the moderates will remain in control for some time to come.

MINERAL OUTPUT
(in 000's l.tons)

	1955	1956	1957
Cobalt alloy	0.373	0.150	**0.0488**
Cobalt metal	0.411	0.900	**0.108**
Cobalt (other) ..	0.287	0.353	**2.259**
Copper (blister)..	165	157.1	**169.5**
Copper (conc.) ..	2.97	0.58	**2.69**
Copper (elec.) ..	177	225.8	**246.6**
Iron ore	2.1	—	—
Lead	19.5	15.1	**15**
Limestone	304.6	367	**449.2**
Manganese ore ..	17.3	39.2	**36.8**
Mica (sheet)	0.0025	0.0026	—
Zinc	27.9	28.5	**29.5**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The African Union's annual convention approved unanimously a new constitution, which has been drafted in co-operation with the Government Labour Department. It includes safeguards which will put the Union's financial organization on a much sounder footing.

Power

In the early months of 1957, work on the great Kariba hydro-electric project in the Zambesi Valley, which is due to deliver its first power to the Copperbelt in 1960 and is expected once and for all to put an end to the chronic shortage of electric power on the Copperbelt, was interrupted by unusually high floods on the Zambesi. The interruption was, however, of comparatively short duration and the lost time was soon made up.

Far more serious were the next rainy season's floods which reached their peak early in 1958. The Zambesi rose to its highest level in living memory and overtopped the circular cofferdam in the middle of the riverbed, inside which part of the main dam wall is being built. The floods also washed away the suspension footbridge and the road bridge which connect the north and south banks of the river at Kariba.

No official estimate of the damage has yet been made, but it is unofficially estimated at between £500,000 and £1,000,000. Impresit, the Italian contracting firm which is building the dam, has expressed confidence in its ability to make up all the lost time by the end of the year, but it is by no means certain that this will be possible. The copper-mining companies are watching Kariba with some concern because their future plans have been made on the assumption that Kariba power will begin flowing to the Copperbelt before the end of 1960.

Meanwhile, in addition to the power generated by the thermal stations at each of the copper mines, the companies are obtaining hydro-electric power from Le Marinel power station on the Lualaba River in the Belgian Congo, 320 miles from Kitwe.

Railway Rates

The copper mines' production costs have been sharply increased during the past year by the decision of the Federal Government, which controls the Rhodesia Railways, to increase the charges for carrying copper from the Copperbelt to the coast, from an average of £7 1s. 4d. a ton to £14 15s. 0d. This increase was first proposed in August, 1956, when the price of copper was £305 a ton. The Railways gave as their reasons for the increase the fact that they needed money to improve their facilities—chiefly for mineral traffic—and that "present copper rates were out of line with the value of the traffic." The increase came into effect on October 1, 1956, when the price of copper had fallen to £282 a ton. The companies lodged objections and asked the Railways to appoint a commission, or employ independent expert consultants, to examine railway rates on all types of freight. In February last year they decided to pay the new rates "under protest and without prejudice" to their case. By then the price of copper had fallen to £246 a ton.

Last April, the companies applied to the Railways for a rates tribunal to consider their case. In the 11 months that have elapsed since then, the companies have been referred first to the general manager of the Railways, then to the Railways Board, and finally to the Federal Minister of Transport. At the time of writing, in March, 1958, there has still been no decision on the question of a rates tribunal and the price of copper, at £163 a ton, is now little more than half what it was when the high value of the traffic first decided the Railways to double their charges.

Other Developments

During the year, the Rhodesian Selection Trust group, at the request of the British Non-Ferrous Metals Federation, decided to revert to the London Metal Exchange basis of copper pricing in order to bring to an end the two-price structure for Rhodesian copper in the U.K. market. The Anglo American group has always sold its copper in the U.K. on the basis of the L.M.E. price, but in May, 1955, R.S.T., at the request of the British Non-Ferrous Metals Federation introduced a fixed price policy, because it felt that the high price then ruling, and the daily fluctuations on the L.M.E., were having an unwelcome effect on the attitude of copper consumers and were making them feel that substitution by some other commodity was inevitable.

In October last year, when R.S.T. reverted to the L.M.E. price basis, price levels no longer constituted a threat to the development of copper as an industrial material and the long-term outlook for the metal was much better than it was in 1955 and 1956. The threat of substitute materials had by then considerably receded.

During the year, the R.S.T. group introduced a scheme which assists about 500 Africans and 3,500 European employees of R.S.T. mines to buy R.S.T. and Roan Antelope shares. This was the first time any company in Southern Africa had made it possible for its African employees to buy shares in the company that employs them, and the first time any mining company in Southern Africa had instituted a share purchase plan of any kind for European and African employees. The scheme is open to any employee earning more than £200 a year. For every £1 subscribed by the employee, the company which employs him subscribes 10s. to buy R.S.T. or Roan shares in the open market.

The Outlook

The greatly reduced copper price will have a serious effect on the taxation revenues of both the Federal Government of Rhodesia and Nyasaland and the Northern Rhodesia Government. The former chairman of the Anglo American group, the late Sir Ernest Oppenheimer, had this to say on the subject:

"Although the fall in the price of metals will have a considerable effect upon the economy of the Federation of Rhodesia and Nyasaland it is fortunate that, at the time the Federation was formed some four years ago, the Government decided that the taxation collected from the copper industry in excess of that which would be accrued from a price of £240 per ton should be set aside for major development projects in the Federation. The price was, in fact, in excess of £240 from June, 1954, to March 1957, and the policy of the Government during this period enabled many vital projects, such as the Kariba hydro-electric scheme, to get away to a flying start.

"The decline in the taxation paid by the copper mining companies must inevitably affect the pace of development in Rhodesia, but the Government has announced that important projects will be protected so far as possible, and, although the general prosperity in the Federation may be temporarily reduced, I hope that this will leave no permanent mark upon the development of the country."

NYASALAND

ATTENTION to minerals in Nyasaland during 1957 was again focused principally on radio-active minerals. Some of the monazite-bearing sands on the western shore of Lake Nyasa have now been fully examined, but development has not yet commenced. The sands contain ilmenite, rutile and zircon as well as radioactive monazite. The deposits on the eastern lake shore have not been investigated to the same extent.

The deposits of uranium bearing minerals, including davidite and betafite, discovered in 1956 by a mining company prospecting in the Tambani area to the west of the middle Shire Valley are still the subject of investigation by that company. It is not yet known whether these are capable of economic exploitation.

Discoveries of uraninite and betafite were reported during 1957; the latter, occurring in the Northern Province, was found by a Government geologist shortly before the onset of the rains, which precluded any further work to determine the extent of the deposit. This will be undertaken, it is hoped, in the dry season 1958.

A British company, engaged in the titanium industry, is making good progress with its investigations of the ilmenite and rutile deposits in the lower Shire Valley between Chiromo and Port Herald. The company has established a laboratory on the site.

The Anglo American Corporation has not done any further field work on the apatite deposit at Tundulu Hill during the year. The results of sampling having shown that the quantity of high grade ore is rather less than had been expected, the Corporation is now engaged in carrying out ore-dressing tests with a view to raising the average grade of product.

The Nyasaland Portland Cement Co. has pressed forward with its project of developing the extensive limestone deposits at Changalumi Hill, west of Zomba.

Interest is still maintained in the vermiculite deposits near Mpatamanga to the west of Blantyre and in the pyrochlore deposits on Chilwa Island. In view of the present low market price and lack of demand for pyrochlore it appears that it would not be economic to work the latter at the present time.

The holders of the mining lease have intimated that they have decided not to do any further work on the cerium-rich monazite at Kangankunde Hill in the Zomba district, in view of difficulties experienced in working out an economic method of extraction for the monazite.

Appreciable interest has been shown in a substantial iron ore deposit in the Blantyre district of the Southern Province and at the end of the year a large trial consignment was being extracted for shipment to Europe.

No mineral production took place in Nyasaland in 1957 though samples were exported for examination and assay.

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THE BELGIAN CONGO AND RUANDA-URUNDI

By Our Own Correspondent

THE following review of the mining position in the Belgian Congo covers the period 1956-1957. At the time of writing complete statistics for the calendar year 1957 are not as yet available.

Compared with the value of the 1955 mine production, that for 1956 totalled Fcs.B.19,379,391,000 or £138,000,000 (140 Congolese Francs = £1 0s. 0d.). This figure represents 65.8 per cent of the total exports from Belgian Congo and was 3 per cent higher than the value recorded for the previous year.

The overall sum of Fcs.B.19,379,391,000 (£138,000,000) represents minerals output in the following proportions:

	Per cent
Copper	56.87
Cobalt	11.31
Tin	8.32
Diamonds	7.76
Zinc	5.43
Manganese	4.48
Gold	3.40
Silver	0.91
Coal	0.79
Various	0.72

Ruanda-Urundi production accounted for 1.60 per cent.

Copper

The reduced value of the copper output, together with the fall in actual production will affect the economy of the Belgian Congo materially.

The Union Minière du Haut Katanga, on the assumption that normal market conditions would prevail, has forecast a production figure of 260,000 tonnes for 1958. However, the fall in price and slackening of demand affected production as follows:

1956 : 247,452 tonnes
1957 : 240,000 tonnes
January 1958 : 15,231 tonnes
(17,575 tonnes in January 1957)

In an official report, Union Minière estimate a production figure of 222,000 tonnes for 1958. Naturally, the course of events, and recovery may dictate a modification of this figure.

The government of the Colony will be affected by an appreciable reduction in revenue from duty on exports, and the economy of the Province of Katanga will be adversely affected as a result of this decline.

The Union Minière's construction work has been adjusted or slowed down, in accordance with the smaller income and decreased demand. The following projects are to be undertaken: construction of the Bodson hydroelectric plant; construction of the second section of the Luilu factory, which is expected to take two years; and equipment of the underground mine at Kambove-Ouest.

It is interesting to note that, particularly at the Shituru electrolytic works a method of reactive flocculants is in use, which increases the capacity of treatment by flotation process. Another event which has assisted operations at this plant was a very abundant rainfall, which allowed the hydroelectric plant to function to its fullest extent, thus avoiding the necessity of importing and consuming coal for the thermal plant.

Cobalt

World production of cobalt in 1956 was 14,500 tonnes, and of this amount the Belgian Congo contributed 9,098 tonnes, comprising 5,100 tonnes of granulated cobalt produced at Jadotville Shituru, and 3,979 tonnes of recovered cobalt from the Panda metallurgical works.

Output of granulated cobalt increased to 419 tonnes in January compared with 398 tonnes in January 1957. Alloys, however, dropped to 254 tonnes in 1956, compared with 860 in January 1957. The Union Minière was able to compensate for the loss arising from the reduced price of cobalt because of the heavy rainfall, which allowed the company to avoid importing coal, since the capacity of the hydroelectric plant could be fully utilized.

In 1956 the treatment plant at Panda stopped using the single-phase furnace and went over to three-phase electric furnaces. Refining is done in a rotating Bracklesberg furnace. The Shituru works have started a process separating cobalt from nickel. Some very interesting results have been obtained in the Société Metallurgique de Hoboken treatment plant at Olen, Belgium.

Zinc

Production of concentrates of crude zinc at Kipushi reached 203,772 tonnes in 1956. Of this, 42,084 tonnes were electrolytic zinc. The electrolytic plant at Kolwezi added 40 electrolytic cells in 1956. Zinc exports from the Belgian Congo in January 1958 were 6,193 tonnes (4,881 in 1957), and 4,220 tonnes of zinc metal (3,270).

Tin

As a result of the installation of new equipment and a constant programme of improvement at the various producing mining companies, the grade of output is subject to constant changes.

Considerable technical improvements have been made in the installations of Géomines, and the expansion of the Piana-Mwanga works has been stepped up from 15,000 to 40,000 CV.

Géomines produced in 1956, 3,805 tonnes of cassiterite and 115 tonnes of colombite-tantalite. The Manono foundry (which also casts the production of other operators) cast 2,913 tonnes of tin in ingots. It also produced about 750 tonnes of tantaliferous dross. The metal produced was sold at 106,800 Congo francs or £755.

Symétain, which celebrated its 25th anniversary during the summer, produced in 1957 5,506 tonnes of cassiterite, 62 tonnes of wolframite and 1 tonne of colombite-tantaliferous concentrates.

In accordance with the provisions made by the Tin Committee, Symétain will deliver during the first quarter of 1958 670.4 tonnes of tin metal or about 894 tonnes of cassiterite concentrates.

In 1957 Kinorétain produced 920 tonnes of tin ore, 929 tonnes of mixed wolframiferous ore, 83 tonnes of mixed colombite-tantaliferous ore, the proportions being 61.3 per cent of cassiterite, 33.5 per cent of wolframite and 1.8 per cent colombo-tantalite.

Minétain produced in 1956, 393 tonnes of cassiterite, 505 tonnes of purified mixed concentrates of cassiterite and colombite-tantalite, 262 tonnes of wolframite and 1,820 tonnes of miscellaneous ores.

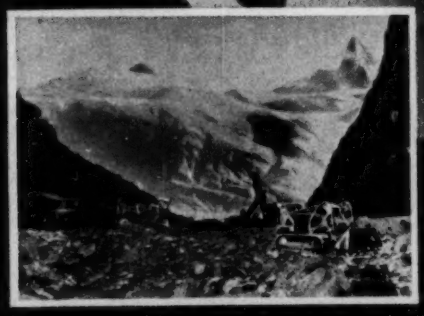
The Ruanda-Urundi mines are suffering from a serious shortage of electrical power. The hydro-electric station at present under construction by the Forces Company will start to operate during the second half of 1959.

Since prices for colombite-tantalite have fallen heavily on account of the recession in the U.S.A., some mines will be closed.

Gold

Production of refined gold in 1956 amounted to 11,525 kilos, worth 648,144,000 francs at the price of 56,243 francs.

The principal producer is the Mines d'Or Company at Kilo-Moto, whose production represents 64.80 per cent of



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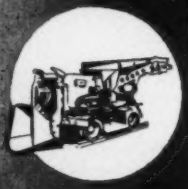
21 ROCKERSHOVEL

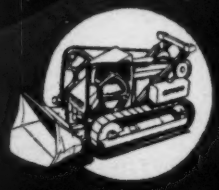
621 ROCKERSHOVEL

40H ROCKERSHOVEL



630 ROCKERSHOVEL

105 TRACTOR EXCAVATOR



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the total for the Belgian Congo and Ruanda-Urundi.

1955 : 7,845,636.44 kilos
1956 : 7,544,875.30 kilos
1957 : 7,454,646 kilos

In spite of the fact that the price of gold has been unchanged since the war, the company's profits amounted to 106,448,387 fcs. as compared with 111,142,172 fcs. in 1955. Vein gold produced by Kilo-Moto amounts to 1,451 kgs. 690 grams and alluvial gold to 6.078 kgs. 610 grams. Gold recovered in the laboratory amounts to 14.5 kgs.

Thanks to its extremely modern cyanide works Kinoretain produced at Namoya 958 kilos refined gold, which was 20 per cent above expectations. This flotation works treated 95,500 tons of ore during the year.

The Minière des Grands Lacs is making preparations for working a substantial vein deposit. For its southern deposit it is employing the cyanamide process.

From refining operations the Union Minière recovered 69 kilos of gold.

Since European labour is not a paying proposition in Mincobel's workings, the company has entrusted the working of recuperable gold to native organizations working under its control.

Diamonds

Lubilash Diamonds produces 97 per cent industrials and crushing boart.

Production was as follows:

1957 : 15,080,000 ct.
1956 : 13,383,509 ct.
1955 : 12,413,199 ct.

Kasai Diamonds which produces a good proportion of gems had an output in 1956 of 627,000 ct. to a value of Fcs.B.205,646,000, which compares with 628,000 ct. in 1955.

A substantial increase should be noted in relation to 1948, giving an index of 254 for Lubilash diamonds and an index of 114 for Kasai diamonds.

The Société Minière du Bécéka has now completed its fleet of powerful earth-moving and gravel transporting machines. At Bakwanga it is installing a very modern works for cleansing and concentration by flotation, process which will replace all the existing washing installations. The first half of the works is to be put into operation at the end of 1958. In Belgian industrial circles its cost is put at Fcs.B.400,000,000.

Manganese and Wolfram

Production figures for manganese ore are:

1955 : 461,732 tonnes
1956 : 340,000 tonnes
1957 : 340,000 tonnes
(approximate.)

In this connection it should be borne in mind that before 1955 a portion of the ore extracted with a content of less than 48 per cent manganese was not sold, but held in stock pending a process of enrichment.

The Société Minière du Bécéka has installed a first washing station which initially effects cleansing. It is building a second washing station which will work by flotation. It thus happens that study of the official government statistics and those of the producing company produces two results. The first set of figures refers to ore extracted and directly saleable and the second to the product which has been treated by flotation; the tonnage dealt with in this way is 329,000 tonnes. The Colonial Government's experts claim that the reduction is apparent, whereas in reality, taking into account the content of the product, exports have increased.

In 1956 the Belgian Congo produced 485 tonnes of wolfram (65 per cent WO_3) valued at Fcs.B.59,595,000.

Silver, Cadmium, Germanium

Refining operations on Kipushi copper in the factories of the Union Minière resulted in the recovery during 1956 of 117,941 kilos as compared with 127,000 in 1955.

Production of cadmium realized during treatment of zinc was as follows:

1955 : 166 tons
1956 : 277 tons
1957 : 409 tons
(114 tonnes from Union Minière).

The cadmium is derived partly from the calcination of the blende by Sogechim, but principally in the plant of Metalkat, or else recovered by the latter at Lubumbashi.

The Union Minière has been successful in treating the dusts collected in the Lubumbashi factory through a process of concentration. These are sent to the factory of the Société Métallurgique de Hoboken which extracted from them:

in 1955: Germanium oxide 1,388 kilos
Germanium metal 143 kilos;

in 1956 Germanium oxide 4,531 kilos
Germanium metal 593 kilos.

The Olen factory handles 1 tonne per month.

Coal

Owing to the more abundant rainfall, it was necessary to work Luena's coalmines to the fullest extent and production therefore fell to 419,000 tonnes in 1956 from 480,000 tonnes in the previous year.

Radium

The Société Générale Metallurgique de Hoboken, the largest radium producer in the world, delivered in 1956 56,234 grammes or 2 oz. of radium. This company has just celebrated the fiftieth anniversary of its foundation. The radio-active ores are supplied by the Union Minière.

Other Mineral Products

	1955	1956
Iron Ore ..... tonnes	12,445	**21,272**
Salt ..... tonnes	458	**510**
Bituminous Sands 15% tonnes	17,764	**24,206**
Monazite ..... tonnes (containing thorium)	4	**1**
Bastnaesite ..... tonnes	324	**356**
Lead-Vanadium Ore tonnes	844	**923**
Beryllium ..... tonnes	328	**1,728**
Amblygonite (lithium Ph.) ..... tonnes	1,353	**1,811**
Platinum ..... grammes	161	**766**

TANGANYIKA

FOLLOWING extensive aerial prospecting in 1956, much detailed ground work has been undertaken in Tanganyika in 1957. With an authorized capital of £1,000,000, the Western Rift Exploration Co. Ltd. took over the special exclusive prospecting licence over 34,000 sq. miles granted to Anglo American Prospecting Co. (Africa) Ltd., which remains in charge of operations. Field work has included investigation of the western part of Chunya district, the basic intrusive at Kungwe Bay, Lake Tanganyika, copper mineralization in the Sango-Karema area and the Ngualla carbonatite.

Interesting mineralization has been found by New Consolidated Goldfields Ltd. in their Northern Province areas, as well as at Wigu Hill, in Morogoro district, where monazite and rare earth minerals have been confirmed. Copper-gold mineralization has been examined by them near Mara. The company has surrendered one of its seven special exclusive prospecting licences following uneconomic results from radio active sources.

Williamson Exploration Ltd. is working on two out of three special licences and a fourth has been granted in Singida district.

Following the completion of investigations into the Kivira-Songwe coalfield, Lake Nyasa, a coal mining lease has been applied for by The Colonial Development Corporation.

In smaller scale activities, scheelite, vermiculite, tin and certain radio-active minerals have been the subject of investigations.

During 1957, BP-Shell continued exploratory work and decided to sink a third deep test oil well on the Tanganyika mainland. Over £1,100,000 was spent by the company in 1957 in prospecting for oil in Tanganyika.

At the end of the year, 27 exclusive prospecting licences covering an area aggregating 36,163 sq. miles, 2,224 claims and 51 leases covering 331 sq. miles were current, as well as an oil exploration licence covering 25,300 sq. miles of the coastal area and off-shore islands.

Actual mineral production in 1957 was valued at approximately £5,460,000. Diamond exports increased, but this was offset by reduced exports of lead concentrates and gold bullion. Total exports are estimated at £5,045,500 compared with £5,017,708 in 1956.

There was a slight fall in the value of minerals consumed within the territory.

Diamonds

Production of diamonds in 1957 exceeded that for 1956 and exports increased by 4 per cent by weight and 1½ per cent by value. In addition to the 7,000 ton per day main concentrator, Williamson Diamonds Ltd. have converted their pilot extraction plant for bulk sampling up to 1,000 tons a day. Although there still remain some mechanical handling problems, the new recovery plant is said to be operating with a high degree of efficiency. The autogenous method of milling is used for scrubbing crushed raw feed in rotary drums, −30 mesh material being rejected. A cone type heavy-media plant treats −1.5 in.+10 mesh material and−10 mesh +30 mesh material is treated in a cyclone type heavy media plant, both systems using ferro-silicon as medium.

Final concentration is with grease belt and electrostatic separator in closed circuit with ball milling and hand selection, only "slimes" escaping from this unit.

Alamasi Ltd. have begun the erection of a new bulk sampling plant and have improved their main treatment plant, output being better than in recent years. Diamonds are expected to be the mainstay of the country's mineral exports for some time.

Other Minerals

Production of lead-copper-silver-gold concentrates from the Mpanda mine of Uruwira Minerals Ltd. suffered through inundation of the lower levels by river flood water in April.

Exports of gold bullion again showed some decline in 1957. Progress was made at the Kiabakari mine of Tangold Mining Co. Ltd., in Musoma district, the main four-compartment vertical shaft having reached a depth of 450 ft. Much of the new 15-20,000 tons per month mill had been completed and an adequate water supply ensured. Output at the nearby Buhemba Mine was somewhat reduced.

At the Geita Mine an increased tonnage was milled. Improvements were made, including the installation of two new 2,000 c.f.m. compressors.

African co-operative societies run by native smallholders were responsible for nearly half the mica purchased by local dealers, most of the remainder coming from four European concerns. With membership standing at over 1,000, the Uluguru Mica Mining Co-operative Society Ltd. was split into two separate societies, both of which had a successful year.

The Mbeya Exploration Co. Ltd., the C.D.C. and Billiton combine exploiting the pyrochlore deposits near Mbeya, have proved further reserves and installed a 150 tons per day pilot mill. The eventual target is some 2,000 tons a day. There are still some metallurgical problems to be solved, but tests indicate that the pyrochlore can be converted without undue difficulty into high-grade metal.

For treating alluvial and elluvial tin deposits Kyerwa Syndicate Ltd., near Bukoba, have under construction a 30,000 ton per month plant. Power is being brought from the Murongo hydro-electric power station and the water supply arrangements were almost completed. The Murongo group of tin deposits and the Kagera Tinfields claims have been taken over by private operators after abandonment by C.D.C. and Billiton respectively. The British Metal Corporation Ltd. tin-buying post at Kikagati was re-opened early in 1957.

Small copper outcrops and some nickel-bearing strata attracted interest at a few places and further drilling was carried out at the Liganga iron ore deposits to gauge their extent. Gypsum production was at about the same level as in 1956. The Tanganyika Meerschaum Corporation investigated deposits on the Kenya border and developed mechanized methods in their opencast mines. Other minerals that received attention were magnesite, bentonitic clays and garnet.

During the year, the East African office of the United Kingdom Atomic Energy Authority was opened at Dodoma to encourage the search for radio-active minerals. Among the various tasks undertaken by the authority was an examination of natural helium sources in the Mara area, said to be the richest in the Commonwealth, which had already been recorded by the Department of Geological Survey. The authority is also interested in all sources of beryllium and has developed a special counter for the detection of beryl alpha particles. This equipment is at present under test.

MINERAL EXPORTS

		1956	1957*
Diamonds	ct.	357,538	**372,738**
Garnet	l.tons	15	**80**
Gold (refined from bullion)	oz.†	59,293	**54,088**
Graphite (crude)	l.tons	23	—
Gypsum	l.tons	9,450	**9,510**
Kaolin	tonnes	10	—
Lead conc.	tonnes	14,251	**12,625**
Lime	l.tons	782	**484**
Magnesite	l.tons	243	**254**
Mica: sheet	l.tons	57	**67**
Mica: waste	l.tons	125	—
Salt	tonnes	9,359	**8,572**
Silver (refined from bullion)	oz.†	35,020	**20,520**
Tin conc.	l.tons	21	**20**
Tungsten conc.	l.tons	15	—

* Excluding gold and silver contained in lead concentrates.

† Provisional.

UGANDA

IN 1957 the total estimated value of Uganda's mineral production, excluding salt and cement, was £1,742,425, of which copper accounted for £1,541,520.

The Kilembe Mines in Western Uganda, which started operations in 1956, increased throughput last year to 48,000 tons per month of 2 per cent ore, due partially to the introduction of wet crushing. The Jinja smelter produced 7,000 tons of blister copper during the year. Its present rate of output is 850 tons a month. Cobalt concentrates are being stockpiled.

Extensions are projected to increase the output of copper ore to 60,000 tons monthly, yielding 1,000 tons of blister. In addition to the sulphide ores now being worked, the company plans to exploit large reserves of oxide ores available near the surface of Kilembe. The new ores will be mined by opencast methods, but a new treatment plant will be required. The extensions and new plant are scheduled for operation in early 1959. Until then the mine will be operating on current production of ore, which is being supplemented by the large existing stockpile. Further surveys are being carried out in the Kilembe area to discover additional deposits of ores or extensions of known orebodies.

One of the biggest known phosphate deposits in the world has been under investigation at Tororo, near the Kenya border, by Sukulu Mines Ltd., a company jointly owned by Frobisher Ltd., the Uganda Development Corporation, and Olin Mathieson. After proving reserves of over 200,000,000 tons of 13 per cent P_2O_5 plus 0.25 per cent of Nb_2O_5 the company is now constructing a treatment plant to handle 45,000 tons per month yielding 100,000 tons of apatite concentrates for conversion to phosphate products.

MINERAL PRODUCTION

		1956	1957
Beryl	l.tons	88	**70**
Copper (Blister)	,,	150	**7,465**
Gold	oz.	271	**243**
Lead Concentrates	l.tons	125	**22**
Iron Ore	,,	1,005	—
Niobium/Tantalum Concentrates	,,	1.56	**1.81**
Phosphates	,,	2,914	**2,256**
Salt	,,	8,853	**9,541**
Tin Concentrates	,,	36	**59**
Tungsten Concentrates	,,	170	**190**
Bismuth Ores	,,	—	—

The metallurgy of niobium still presents difficulties. Sulphuric acid may be made on the spot from sulphides mined in East Africa, both Kilembe and Macalder having been mentioned as being possible sources.

Production of galena fell to 22 tons from the 1956 total of 125 tons, which was the highest hitherto recorded in Uganda. The entire production comes from the Kitaka Location on the Ankole-Toro border. Unicorn Mines Ltd., who hold an option over the Kitaka prospect, have experienced difficulties due to falling base metal prices, but are reorganizing to increase their production rate.

The production of tungsten concentrates is still rising and amounted last year to 190 tons compared with 170 tons in 1956 and 144 tons in 1955. After reaching its lowest ebb in 1956 when output fell to 36 tons of concentrates, tin production rose during the year to 59 tons. This improvement was not unexpected, since several small operators have taken over the various holdings of Kagera Mines Ltd., which closed down in 1956, and are treating tailings and detrital remnants. The British Government's contract for the bulk purchase of wolfram from Uganda was not renewed.

Apart from the minerals listed in the accompanying table, production in 1957 included 5 tons of lithium ores and 2 tons of bismuth ores.

KENYA

MINERALS worth approximately £3,850,000 (including cement) produced in Kenya in 1957 showed a slight increase in value over 1956. Copper and cement showed the largest gains but these were largely offset by reductions in other minerals.

Gold

Valued at £91,000, gold output was much reduced as mounting costs continued to take toll of producers. Of the total produced about one-quarter came from Macalder Nyanza Mines Ltd., where it is produced with copper from a mixed sulphide orebody. Blister copper from this source totalled 2,115 tons.

C.D.C. Macalder Mines Ltd. dealt with problems connected with the treatment rate of the Dorr Fluosolids sulphate roaster and the cyaniding of leached sulphate residues for gold and silver. In addition, the world's first commercial scale Kalling sponge iron producing kiln was constructed and put into operation in November. The company is investigating

other local copper occurrences. Gold is being produced on a limited scale in the once famous Lolgorien gold belt and in the Kibigori area there are prospects of fresh discoveries.

During the year, the Magadi Soda Company Ltd. produced 118,440 tons of soda ash and 16,185 tons of salt and improvements to processing and recovery techniques were continuing.

Work was continued by G.F.K. Refractories Ltd. in re-equipping their mill and kyanite mine at Murka. Flaked graphite production from the Shah Vershi Devshi mine in South Kitui at 942 tons was more than double that of the previous year, in spite of difficulties in producing crucible grade material at a price to compete with the Madagascan product. The Mines Department were carrying out extensive flotation tests. Outputs of diatomite and of CO_2 were somewhat reduced.

MINERAL PRODUCTION

		1956	1957
Asbestos	l.tons	152	
Copper	,,	189	**2,115**
Diatomite	,,	4,837	**4,229**
Gold (refined)	oz.	13,842	**7,387**
Graphite	l.tons	553	**942.5**
Gypsum	,,	1,908	**29,076**
Kaolin	,,	1,499	**1,140**
Pumice	,,	1,635	**2,071**
Salt	,,	21,885	**22,602**
Silver	oz.	54,689	**23,051**
Soda ash	l.tons	146,326	**118,440**
Vermiculite	l.tons	440	**30**

Production in small, or relatively small quantities, was achieved of columbite, felspar, gypsum, limestone, magnesite, meerschaum, pumice, quartz, salt from sea water and vermiculite.

Investigation of the niobium-bearing prospect of Mrima Hill was continued by the Anglo American Prospecting Co. (Africa) Ltd. and Power Securities Ltd. and the East African Power and Lighting Co. Ltd. continued to drill in their exclusive prospecting licence area.

During the course of the year, the Geological Survey mapped geologically over 11,000 sq. miles, bringing the total area so covered to approximately 92,000 sq. miles, or over 40 per cent of the total area of the colony.

MOZAMBIQUE

MANY minerals are found in Mozambique, but deposits are scattered through mountainous regions away from the coast and so far few occurrences of major economic value have come to light.

In 1956, the latest year for which statistics are to hand, mining production included 1,247 oz. of gold, 42 oz. of silver, 339 l.tons of asbestos, 3,705 tons of bauxite, 842 tons of beryl, 7 tons of bismuth, 3 tons of tantalite, 321 tons of uranium minerals, and 214,851 tons of coal.

Prospecting activity continues to increase. Among the companies engaged in exploration is the Companhia Geral Mineira do Chidue, S.A.R.L., a company formed in accordance with the terms of a contract between the Portuguese Government and the Central Mining and Investment Corporation, which holds a mineral concession over 200 sq. miles in the Tete area. The period of the concession is seven years with option on a further period of seven years.

A decree published on May 11, 1957, announced the Portuguese Government's plan to encourage prospecting for radioactive minerals in Mozambique under certain specified conditions and safeguards. Henceforth, prospecting for radioactive minerals is only permitted under a special mining concession, or a special mining contract with the Central Government in Lisbon through the Portuguese Overseas Ministry.

A coal and chrome handling plant is to be installed on a wharf to be constructed in the Lourenco Marques estuary.

ETHIOPIA

THE Goldfield Consolidated Mines Co., Newmont Mining Corporation, and Natomas Co. have closed down their prospecting and exploration operations in Ethiopia without finding any "worthwhile" deposits.

Hunting Aerosurveys, of London, is engaged on an extension to an aerial survey contract awarded by the Imperial Highway Authority of Ethiopia earlier in 1957.

Gold production amounted in 1956 to 25,700 oz.

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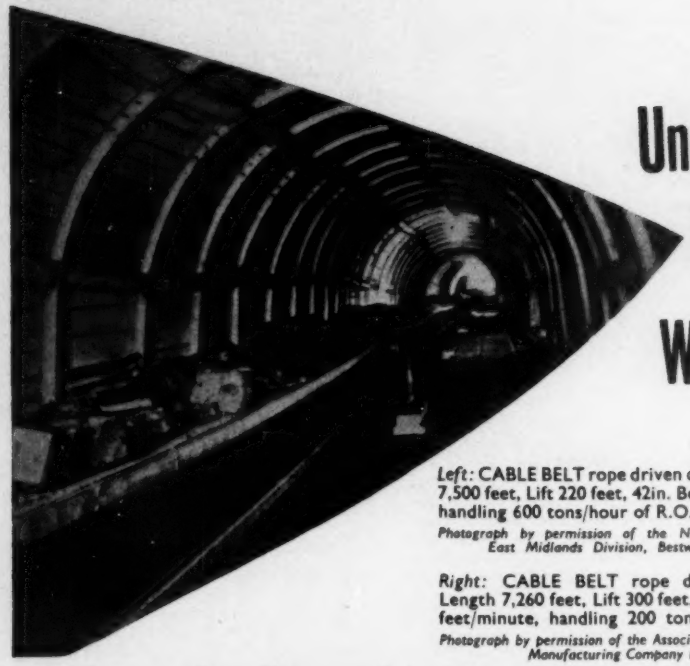

Underground or Surface
Whatever the Load
Whatever the Distance

Left: CABLE BELT rope driven conveyor. Length 7,500 feet, Lift 220 feet, 42in. Belt at 350 ft./min. handling 600 tons/hour of R.O.M. Coal.
Photograph by permission of the National Coal Board, East Midlands Division, Bestwood Colliery.

Right: CABLE BELT rope driven conveyor. Length 7,260 feet, Lift 300 feet, 24in. Belt at 200 feet/minute, handling 200 tons/hour of chalk.
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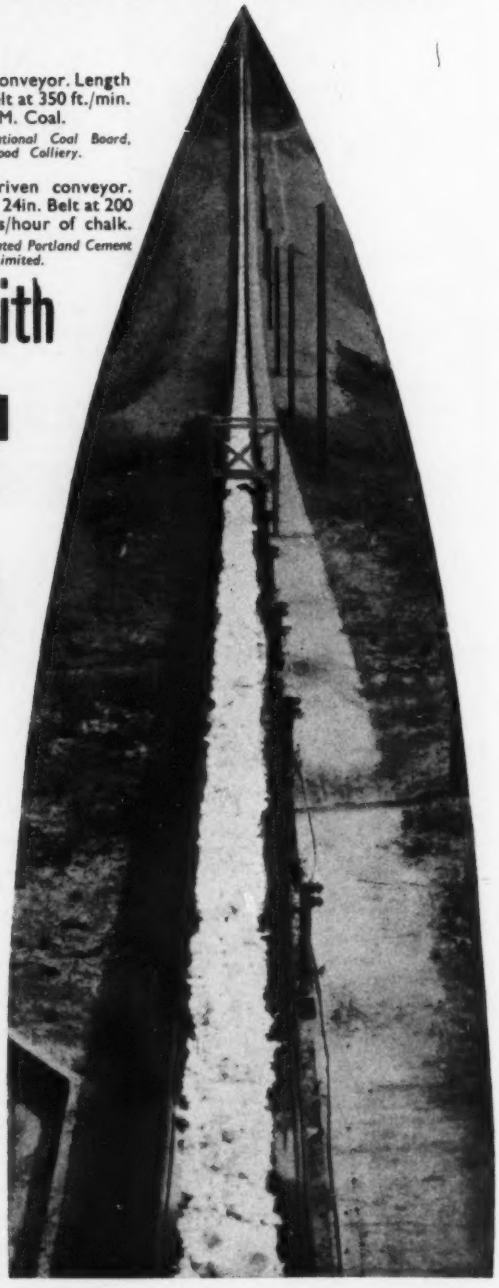

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West Africa

GHANA • SIERRA LEONE • NIGERIA

GAMBIA • ANGOLA • LIBERIA

GHANA *by A. Graham Thomson*

GHANA's progress and policy during its first year of self-government augur well for the future of this young nation. The year has not been an easy one, politically or economically, but its close finds Dr. Nkrumah's administration firmly in the saddle. There is no doubt that the Government is in a stronger position and is gaining in power.

Considerable efforts are being made to attract foreign capital. Emphatic assurances have been given that the Government has no intention of nationalizing any mines.

Legislation

Two Bills which will benefit British mining interests were published in November, 1957. One is a mineral profits tax bill and the other an income tax amendment bill, made necessary because of the introduction of the first. The aim is to introduce a new form of taxation on mines which would be eligible for relief under the existing British double taxation order of 1947. In order to ensure as nearly as possible unanimous approval for the legislation, the second reading of the mineral profits tax bill has been postponed.

A five-man commission has been appointed to enquire into concessions governing mining, oil and timber operations in Ghana. It has been directed to finish its work by September 30 and submit a report to the Minister of Trade.

Gold

Within the framework of the present administration in Ghana, the gold mining industry not only has full scope to develop unharmed by Government restriction, but has also received the fullest co-operation from the Government towards the peaceful settlement of wage disputes. Furthermore, the Government has shown itself fully aware of the difficulties experienced by low grade mines owing to the fixed price for gold, and has done all in its power to alleviate these difficulties.

There is now no question about the ranking of the Ghana gold mines as Overseas Trading Corporations for U.K. tax purposes. Broadly speaking, the industry is likely to benefit from lighter taxation, though the incidence will vary from one mine to another.

In July, 1956, the Government made a grant of £200,000 to the marginal mines to cover the period from June, 1956 to July, 1958. It has now undertaken to bring out to Ghana an independent mining expert who will report on the state of the gold mining industry with a view to new legislation granting a subsidy to marginal or low grade mines on the lines of similar legislation enacted in both Canada and Australia.

The outputs of the individual gold mines during 1956 and 1957 are shown below.

Ashanti, probably the richest gold mine of its size in the world, is forging ahead with a development programme which continues to expose extremely rich ore with large tonnages at the lowest level of the mine. From August, 1958, the new Eaton-Turner shaft will start handling large tonnages of high-grade ore from the deeper levels. Ore reserves, as recalculated at September 30, 1957, were 1,449,984 tons of an average grade of 19.1 dwt./ton.

Ariston is happily placed from all technical points of view. Efficiency at the mine is being improved all round and the ore position is good.

Development is being rapidly accelerated and from the results it appears that both of the mine's major sources of ore are improving at depth; the North orebody in length and the No. 2 in values. Available ore reserves show an increase of 97,338 tons with an increase of 13 in. in width and 0.31 dwt. in value.

During 1957 Bibiani milled the record total of 371,843 tons and gold recovery, 77,992 oz. was the highest since the end of the war. Output for the current year was planned to be 33,500 tons milled to yield 6,900 oz. It was recently decided, however, to increase the milling rate to 35,000 tons a month to compensate for the comparatively low-grade ore now being extracted from the South Quarry. The future of this mine depends on the discovery of major orebodies and to this end exploratory development has been considerably intensified.

Last year Ghana Main Reef achieved the remarkable feat of reducing costs per ton milled by no less than 8s. 8d. Nevertheless profit remained almost stationary, declining grade (1956, 7.1 dwt. per ton; 1957, 6.2 dwt. per ton) being to blame. To compensate for the difficult grade position throughput was speeded up, totalling 142,395 tons compared with 114,063 tons in the last full year before the strike. Full capacity has now been attained. Ore reserves again showed a satisfactory increase. As at June 30, 1957, they amounted to 371,201 tons averaging 8.49 dwt. over a width of 77.0 in., an increase of 14,787 tons, an increase in width of 4.1 in. and in value of 0.18 dwt.

During the year ended September 30, 1957, Konongo milled 59,290 tons, the highest figure attained in recent years. The grade continues to fall, however, and the gold production of 47,456 oz. represented a yield of 16 dwt. per ton. At the end of the financial year the total reserve stood at 189,410 tons averaging 14.5 dwt. over 66 in. equal to over three years' supply for the mill at the 1956-57 crushing rate.

Amalgamated Banket Areas has passed through a transition period and since the opencast workings at Pepe were closed in August, 1956, all ore has come from underground sources. During the 12 months immediately following the shut-down of Pepe, monthly production averaged 58,000 tons at an average grade of 4.2 dwt. This rate of production has been increased since October, 1957, and now averages 62,000 tons at 5.0 dwt., which it is hoped, by intensive development, to maintain for some years to come.

As can be seen from the table, Bremang dredged a slightly reduced yardage during 1957, with a corresponding reduction in the quantity of gold recovered.

Of the four dredges operated by the company only three worked a full year and in each case showed a considerable increase in yardage dredged and in gold produced. The fourth dredge ceased operations on the Ankobra River on February 18, 1957, and was transferred to the Jimi River where it started full operations on September 12, 1957. The transfer of this dredge, which was completed in the record time of seven months, is the only reason for the overall decrease in production of this company.

Diamonds

During the year ended June 30, 1957, Consolidated African Selection Trust Ltd. treated over 25 per cent more gravel than in the previous year and recovered about the same quantity of diamonds, while working to a lower grade. This was in accordance with the company's policy to increase yardage throughput by mechanization and double-shift operations in order to extend the life of the mine.

GOLD OUTPUT

	1956		1957	
	tons (000's)	*oz.* (000's)	*tons* (000's)	*oz.* (000's)
Amalgamated Banket Areas	599	119.9	710	147.1
Ariston	377	70.3	475	147.3
Ashanti	263	216.7	334	273.5
Bibiani	300	66.7	360	77.9
Bremang (cu. yd. dredged)	8,454.7	43.2	8,130.0	41.5
Ghana Main Reef	112.6	33.3	139.2	48.3
Konongo	44.6	40.3	60.5	47.0

MINERAL EXPORTS

	1956	1957
Diamonds .....ct.	2,518,563	3,042,552†
Gold* .....f.oz.	638,000	790,000
Silver .....oz.	32,966	27,700†
Manganese ore l.tons	647,995	684,500
Bauxite .....l.tons	137,873	137,800

*Production. †Estimate based on 11 months.

Construction has started on the company's new washing plant at Aninchecheche, which will eventually have an annual capacity of 300,000 cu. yd. Completion of the first half of the plant is scheduled for the middle of 1958. Revised estimates indicate that the total cost will be about £800,000.

The Geological Survey has been carrying out investigations into the evaluation of the alluvial diamond deposits without which adequate control over the African workings could scarcely be achieved.

Aluminium

The Ghana Government is vigorously exploring all possibilities of financing the Volta River project, on which Dr. Nkrumah is reported to have set his heart. The project, as now envisaged, provides for the construction of a generating station with a power potential of 617,000 kW and for an integrated aluminium industry with an eventual production capacity of 210,000 tons of aluminium ingot per year.

Aluminium Ltd. of Canada has decided that it is not in a position to proceed immediately with this project, but announced that it would not stand in the way of other interested parties. The Ghana Government is now examining the position in consultation with the U.S. Government. It is understood that Aluminium Ltd., which holds large bauxite concessions in Ghana, would be prepared to negotiate for their ultimate release provided that the Volta scheme was implemented, while still continuing to maintain an interest in the project.

Other Minerals

Ghana's only producer of manganese is the African Manganese Co. at Nsuta. In 1957 this company shipped 684,500 l.tons of manganese, compared with 635,381 tons in 1956.

Iron ore has been discovered in several parts of Ghana and is now being examined by the Geological Survey Department.

The Gulf Oil Co. has made three unrewarding attempts to locate oil in its concessions in the Western Nzima district. A fourth attempt is to be made.

SIERRA LEONE

By a Special Correspondent

SINCE the last war illegal diamond exports and illicit mining have had a serious effect on the economic and social life of Sierra Leone. The population in the diamond mining areas had been swollen by large numbers of "strangers"—both from other parts of Sierra Leone and from the neighbouring French territories—and this, coupled with the drift of labour from agriculture to the supposedly lucrative pursuit of diamond mining, led to a heavy fall in the production of palm kernels, the principal export crop, and of rice, which is of course, the basic ingredient in the diet of the people. This result, in conjunction with the extra money circulating in the country as a result of illicit mining, led to a sharp rise in the cost of living. It is, however, encouraging to note that the decline in the production of palm kernels has been arrested and that the harvest of rice in 1957 was above average for recent years.

Mining costs have continued to rise and a further wage increase of about 10 per cent was ordered by the Mining Workers Board towards the end of the year. This wage claim and those in other industries were mainly caused by the continuing inflation in the country. A voluntary sick pay scheme was introduced at the major mines during the year.

Diamonds

Despite the passing of the Alluvial Diamond Mining Ordinance in 1956, which made it possible for natives of Sierra Leone to take part legally in the mining of diamonds on their own account, and the expulsion in the last quarter of 1956 of large numbers of African immigrants who had been coming into the country from the neighbouring French territories for several years past, illicit mining continued on a large scale culminating in August, 1957 with an invasion by thousands of illicit miners of the areas leased to Sierra Leone Selection Trust. Following the attempted arrest of some of these men, there were outbreaks of violence and riots. The Government declared a state of emergency and moved reinforcements of police and military to restore law and order.

Large areas of Sierra Leone have since been declared "diamond non-dealing areas" and it has been made an offence for any person to be in possession of diamonds in these areas unless they hold a special permit issued by an Area Superintendent of Mines. In addition the Government have introduced regulations devised to limit the movements of "strangers" in Chiefdoms in "the diamond non-dealing areas," and to effect a tighter control over diamond dealers. A number of dealers' licences have also been revoked.

In spite of these measures, there is no doubt that the illegal export of diamonds continues, presumably because it yields a higher profit than exporting through official channels. Another factor is that few African miners have capital of their own and they are 'grubstaked' by traders to whom any diamonds found must be sold, so that the miner himself often obtains only a fraction of the value of any of his stones. It was proposed to remove the export tax and alluvial tax from diamond purchases in order to enable the official buyers, The Diamond Corporation Sierra Leone Ltd., to offer better prices, but the proposals were not implemented.

That the policy of introducing The Diamond Corporation as official buyers has had some success is illustrated by the fact that the official figure of the value of diamonds exported during 1957 was £5,000,000 compared with £1,000,000 in 1956.

Sierra Leone Selection Trust produced a larger caratage of diamonds in 1956 than in 1955 and it seems likely that the company will again have increased their production in 1957.

The new treatment plant at Tongo in the Panguma area, some 30 miles distant from the company's main working areas, was brought into operation towards the end of the year. The total cost of constructing and equipping this plant with modern machinery was over £500,000.

Iron Ore

The Sierra Leone Development Co. Ltd. iron ore mine at Marampa worked at full capacity throughout 1957 and shipments totalled 1,487,782 tons against the previous year's total of 1,311,988 tons. This tonnage constitutes a record for the mine. The Customs valuation of the iron ore exports is at approximately the same rate as the previous year. The distribution of the tonnage in the various markets was virtually unchanged with the U.K. receiving 49.90 per cent, Germany 25.31 per cent, Holland 12.27 per cent, U.S.A. 10.64 per cent and Austria 1.88 per cent. The total includes over 1,000,000 tons of concentrates containing 66 per cent Fe. Construction of a new concentrating plant was commenced during the year and it is hoped that the new plant will be in operation in late 1958. Provision is also being made for a new stocking and reclaiming plant at the company-owned iron ore port of Pepel.

The geological exploration of the iron ore deposits at Tonkolili was continued by the company throughout the year and it is hoped that it will be completed during 1958. As yet no date has been announced for the development of these deposits.

Other Activities

The Sierra Leone Chrome Mines Co. Ltd. continued to mine ore from its chromite deposits in the Kambui Hills near Ngerihun, exploitation now being entirely by underground methods. Exports for the first six months of 1957 were 9,227 tons value at approximately £133,810. The development of underground operations imposes a severe burden on the company in meeting competition from chromite producers in countries where costs of labour and of internal transport are considerably lower than those in Sierra Leone. Detailed prospecting, including considerable diamond drilling, is being continued in the Kambui Hills, whilst geological reconnaissance over a much wider area is also being undertaken.

British Titan Products Co. Ltd. and their American associates, Columbia-Southern Chemical Corporation, have completed their initial prospecting programme for ilmenite and rutile in the Bonthe area. Evaluation of the alluvial deposit found is in progress.

GAMBIA

IN 1953 deposits of ilmenite, Gambia's only exploitable mineral, were located on the coast south-east of Bathurst by a party of prospectors led by Dr. Joyce. At Brufut these deposits were found in sufficient quantities for them to be commercially exploited and following an agreement with the Gambian government in 1954 Gambian Minerals Ltd., a subsidiary of British Titan Products Co.

Ltd., installed plant with the intention of shipping ilmenite to the parent company in Britain. The deposits are very limited in extent and will be exhausted within six years. Ilmenite cannot, therefore, be considered a permanent asset to the Gambian economy. As by-products, the company separates some rutile and zircon.

The company produces about 40,000 tons of ilmenite per annum and employs about 650 Africans and a European staff of 25. Africans are in charge of shifts in the dry mill and they operate the draglines on the mining site, which is five miles away from the mill. A link between the two is provided by a narrow gauge railway. On the site the crude sand is reduced by sand hoppers and jigs to a mixture of about 20 per cent sand and 80 per cent heavy minerals. It is then transported by rail to the dry mill where it is electrically separated and then taken to the company's dock at Bathurst where it is shipped to Britain.

NIGERIA

POLITICALLY, the most significant event during 1957 was the Constitutional Conference held in London in May and June. The Conference failed to reach agreement on a date for granting the Federation full self-government within the Commonwealth, but proposals were agreed for granting of complete independence to the Eastern and Western Regions on all purely regional matters.

In an effort to attract badly needed investment, the Nigerian Government's Budget proposals for the current fiscal year included a reduction in company tax from 9s. to 8s. in the pound. No other major changes in taxation policy are proposed, pending the report of the Fiscal Commission.

The number of operators engaged in mining rose to 166 in 1957 from 153 in the previous year. The labour force employed last year in mining and prospecting comprised 384 non-Africans and 58,160 Africans. Wages paid to African workers totalled £3,310,987.

Tin Production

Output of cassiterite continued to expand at an increasing rate up to the end of November and for the 11 months from January to November reached a rate of nearly 13,300 tons a year. In December, however, the statistical position for tin showed a critical surplus which forced the International Tin Council to introduce restriction of exports of tin from producing countries within the Agreement as from December 15, 1957. The average overall restriction imposed on all producers is now 40 per cent, but the individual effect for Nigeria in relation to its present high and expanding productive capacity has been to impose a 48½ per cent cut. As a result of this restriction, laws were introduced to allow of production and export of cassiterite under licence only.

In addition to the introduction of restriction, the first subsequent contribution to the Buffer Stock was called up early in December after the Buffer Stock manager had advised the Council that stocks of tin metal in the Buffer Stock had reached 10,000 tons. This contribution, which in the case of Nigeria amounted to £194,910, was called for and paid in cash. The second subsequent contribution of the same value of £194,910 also became due at the end of December, when the amount of tin metal in the Buffer Stock reached 15,000 tons. The floor price of £730 a ton tin metal was held by the operations of the Buffer Stock manager.

The Nigerian Government has made available to producers facilities whereby they may obtain Government loans at 4 per cent interest to finance their buffer stock contributions. These loans are not repayable until such time as the buffer stock may be liquidated in the event of the agreement being terminated.

Columbite

The market for columbite remained depressed; save for a few outstanding contracts, sales were rare and the price remained low with normally a nominal market quotation. Production at 1,055 tons was higher in the first half of the year but decreased progressively from 241 tons in July to the lowest monthly total for five years of 113 tons in December.

The Position Since Tin Restriction

Nigeria did not feel the impact of tin restriction until after the end of the year under review. The consequences have, however, been sufficiently serious to call for notice. The introduction of quotas has hit Nigeria harder than any other producing country because, partly as a result of the late columbite boom, she happens to have had an exceptionally rapid expansion of her tin industry since the pattern of quotas was established in 1953. Inevitably this has meant that the proportionate cutbacks on the Plateau have been higher than elsewhere with the exception possibly of Thailand.

For most Nigerian tin producers the position is complicated by the fact that they are also columbite producers. In one respect this has worked to their advantage in that tin-columbite producers have been granted a special concession under the I.T.A. whereby their maximum permitted level of tin stocks is 50 per cent of their annual rate of production immediately prior to restriction instead of 25 per cent in the case of other member countries. This has enabled them, at any rate in a short term, to produce more columbite than would otherwise have been possible, but the immediate benefit of this is slight owing to the present state of the columbite market. Should this market pick up, however, here is an immediate additional source of revenue to hand. Meanwhile the financing of these large stocks of tin and columbite must be a substantial drain on the companies' resources, which is of course additional to financing of their buffer stock contributions.

These additional burdens bear particularly on those tin-columbite producers who have already over recent years committed themselves to substantial capital expenditure (mainly on improved mineral dressing plant) at a time when they sought to maximize their production in response to defence requirements and it has been their misfortune that the high prices generated by this demand were not sustained for long enough to enable them to amortize this expenditure. Now, of course, with the advent of tin restriction and consequently of much reduced gross profits, the writing off of this expenditure becomes increasingly difficult.

The generally reduced scale of mining operations in Nigeria during the early part of this year has naturally been cause for official concern and the Regional Government has been actively applying itself to the problem of creating alternative employment. In this connection various public works projects are being pushed ahead, notably the rail extension from Kano to Maiduguri, as well as many road improvement schemes.

MINERAL PRODUCTION
(in l.tons)

		1956	1957
Coal		787,209	**815,272**
Cassiterite		13,364	**13,150**
Columbite		2,406	**1,923**
Tantalite		15	**17.00**
Wolfram		5	**1.83**
Lead-Ore		105	**623**
Monazite		77	**93**
Thorite		727	**1,154**
Gold	f.oz.	440	**487**

Lead-Zinc

No progress was made in the re-opening of the Abakaliki mine but negotiations were continued regarding the financing of the project. Production came mainly from a small underground working near Wase, which produced 400 tons galena in the first half of 1957, dropping to 177 tons in the second half.

Minor Minerals

A strong demand built up for tantalite and stimulated interest in this mineral. Known occurrences are small and sporadic, but the demand stimulated production from 6 tons in the first half of the year to nearly double that in the second half. There was a steady production of monazite from alluvial sources and of thorite produced from mill rejects from primary columbite processing.

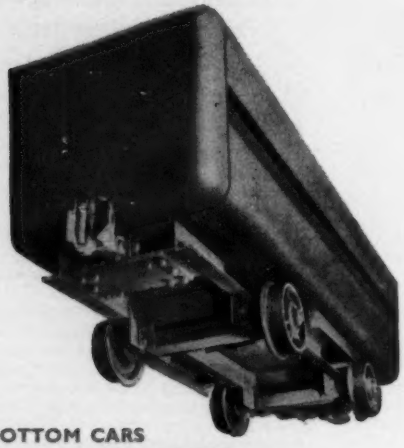
Coal, Oil and Limestone

Coal production for the year was 815,272 tons and the output in June of 73,810 tons was a record. Exports all of which were to the Gold Coast totalled 104,470 tons and royalty on coal sold in Nigeria amounted to £213,240. Development of the new Ekulu colliery was continued by the extension of the two main drifts, cross cutting and the driving of coal proving headings. The No. 3 seam was fully exposed in No. 2 drift showing a thickness of 5 ft. 5 in. with a 4 in. dirt band in the middle.

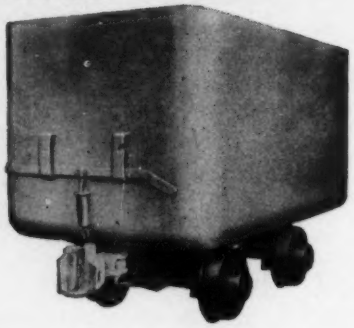
The chairman of the Nigerian Coal Corporation has stated that the coal mines near Enugu may be producing 1,000,000 tons a year by 1960 to meet increasing demands.

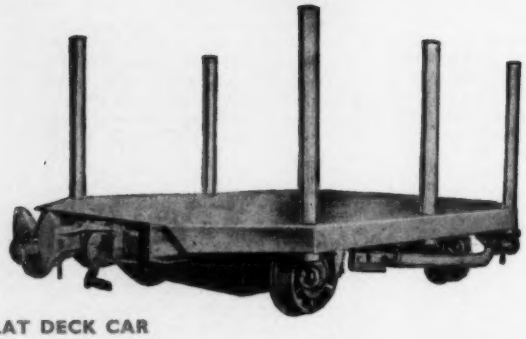
Oil exploration and prospecting was continued at an increasing tempo by the Shell-B.P. Petroleum Development Co. of Nigeria Ltd. The first commercial production resulting from the tests of the Oloibiri reservoir was stored at Port Harcourt in December. Of the seven appraisal holes drilled at Oloibiri, four encountered oil and three were dry. Of the five wells drilled at Affam, three were found to be productive and two dry. It is expected that the first tanker of oil will leave Nigeria in February, 1958. An exploration well was spudded in at Ossiomo in the Western Region in December.

Mobil Exploration (Nigeria) Ltd. reduced the area of their exploration licence in the



SOLID BOTTOM CARS





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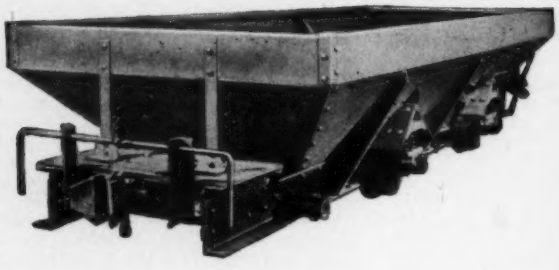
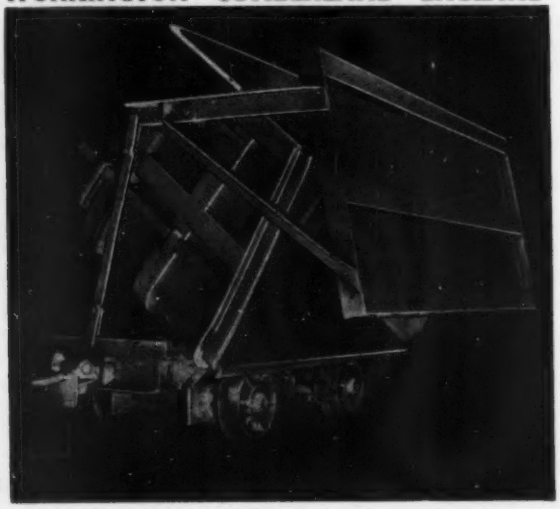


AUTOMATIC DROP-BOTTOM CAR



GRANBY TYPE CAR

Northern Region and are concentrating work in the Sokoto area where a programme of seismic prospecting is being carried out.

The Nigerian Cement Co. plant at Nkalagu in the Eastern Region was opened by His Excellency, the Governor-General on December 20, and cement production has now started there. A total tonnage of 45,221 tons of limestone was quarried for use in the factory. Limestone investigations with a view to establishing cement industries were continued in both the Western and Northern Regions.

LIBERIA

PLANS for the development of the Liberian mining industry will soon be translated into action. These include the opening up of an iron ore mine at Nimba, necessitating construction of a 250-mile railway to a site at the coast where a new port will be built. The Liberian-American-Swedish Minerals Co., which is responsible for opening up the deposits at Nimba, is believed to be a consortium of companies among whom are Grangesbergsbolaget, the Atlas Copco group and a leading Swedish civil engineering company, S.E.N.T.A.B. It is also believed that a U.K. and an American concern are represented. Some £25,000,000 is being invested by the consortium in this large project. The Liberian Government's stake is credited at a further £25,000,000, the larger part being represented by mineral rights.

At the Liberian Mining Co.'s Bomi Hill operation, opened in 1946, a new Bucyrus Eyrie B dragline will shortly be installed to augment the excavating units. The run of quarry material at Bomi is fed to a gyratory crusher, followed by screening to eliminate fines which carry the low-grade material. A high-grade product for shipment is achieved, but with the production of a substantial stockpile of low-grade ore. In order to deal with this stockpile a treatment plant will be erected. This, together with ore from a proposed new quarry, will raise production from its present level of 2,500,000 tons per annum to over 7,500,000 tons by 1959.

The Krupp organization has carried out some work in Liberia, but there is no indication yet of the extent of their interest in workable deposits of iron ore.

Rutile deposits along the coast have been examined by Columbia Southern.

President Tubman announced that large deposits of diamonds had been proved in Liberia and recommended regulation of their workings, sales and exports.

ANGOLA

PRODUCTION of diamonds by the Angola Diamond Co. during 1956 achieved the highest level (by value) ever recorded, with 798,226 ct. value 392,321 contos). Prospecting for new deposits continued in the Luanda and Malange districts.

The establishment of a diamond cutting and polishing industry in Portugal, authorized by Portuguese Government decree in February, 1957, has now come into being. Diamonds mined in Angola province, which hitherto have been exported direct to offices of purchasing firms in London, will in future be exported to Lisbon, where they will be classified and valued.

The Portuguese Government and N.V. Billiton Maatschappij have formed a limited liability company (Companhia Lusitana do Aluminio da Guine e Angola) to seek and exploit aluminiferous ores in the two territories indicated by the name.

Plans are reported to have been drawn up and submitted to the authorities for the construction of an aluminium reduction plant in Angola. A production of between 50,000 and 60,000 tons per annum is proposed. As yet no official decision has been made known.

Prospecting carried out by Petrofina has proved that oil extraction can be made an economic proposition. A final decision about the erection of an oil refinery at Luanda to produce an initial 1,000,000 tons of refined products per annum has been deferred for three years. A pilot plant is expected to be in operation by mid-1958. The estimated yield of the oil wells in Angola is currently placed at not less than 300,000 tons.

It was announced in August, 1957, that exploration for oil in Angola would be undertaken by the Companhia de Combustiveis do Lobito. The Cabinda Gulf Oil Co., a subsidiary of the Gulf Oil Corporation, has been granted a concession to prospect for petroleum and hydrocarbons in liquid gas or solid form in the Cabinda region.

Angolan exports in the first eight months of 1957 included 39,218 tons of iron ore, 25,136 tons of manganese, and 1,102 tons of copper metal. An output of 34 oz. of gold was recorded for 1956.

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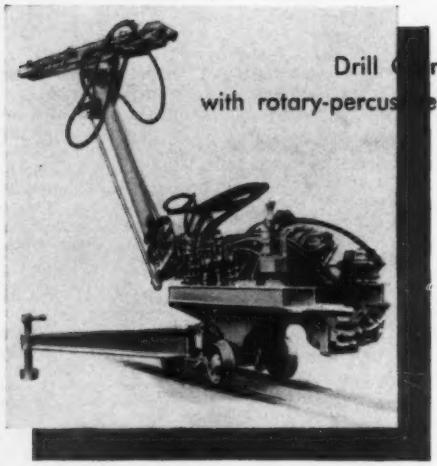
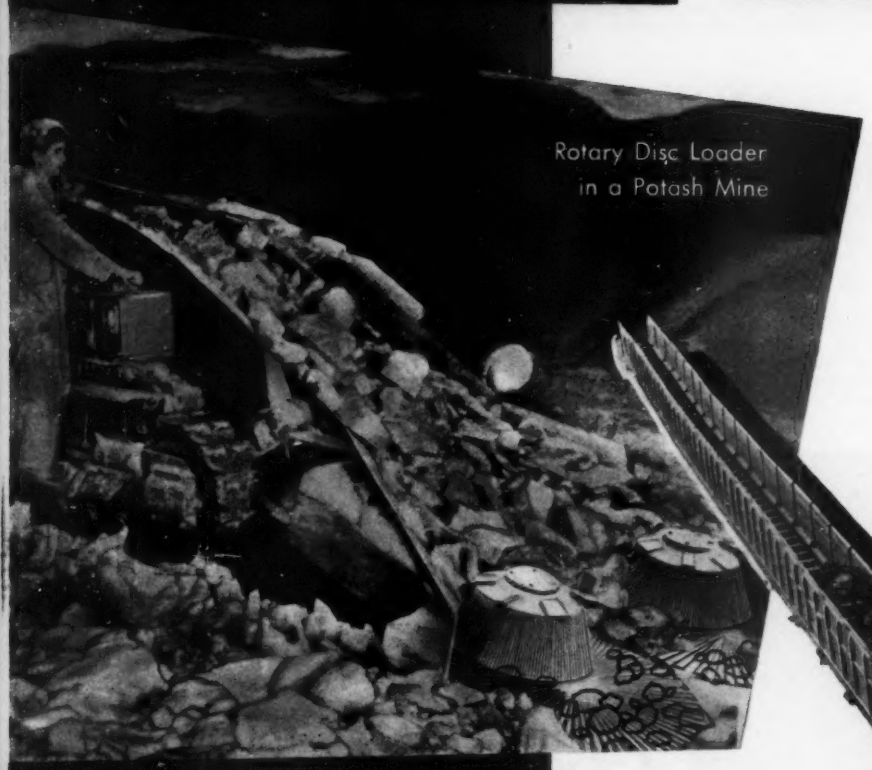
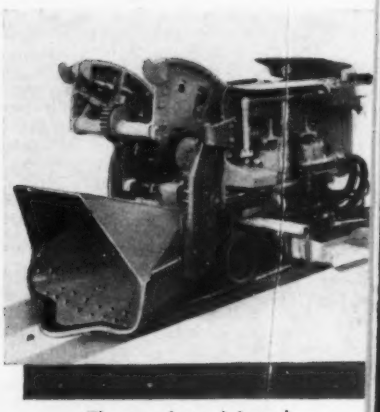


Drill C riage
with rotary-percus e drilling machine

MINING MACHINES

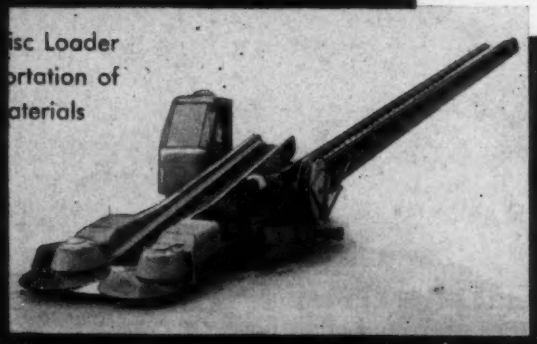


Rotary Disc Loader
in a Potash Mine



Throw-shovel Loader

Bunker Train
with throw-shovel Loader



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French Sphere of Influence Overseas

By R. M. BLOCK

DURING the year 1957 the mining industry in all the territories under French control was again maintained at the satisfactory level which has been experienced in the past few years, and prospects are most encouraging

Algeria

In spite of insecurity resulting from the political situation, the South Oranais coal mines were able to maintain their annual production at a rate of over 200,000 tonnes (a daily rate of over 550 tonnes being achieved in the last quarter); some interesting work was also undertaken in prospecting.

There was a 6 per cent increase in the rate of iron ore production, when a better offtake was arranged at the Ouenza mines, but it has not been possible to proceed with exploitation of the mining area near the Tunisian frontier, and this will have to be deferred to a later date.

It has been found necessary to cease work on certain zinc deposits which were situated in vulnerable areas, and the situation of the antimony mines is very precarious. To offset this, however, there has been increased activity at the copper mine at Ain Barbar, whence the output can be transported by sea, and a good recovery was made by the pyrite mine at El Halia, after considerable renovation work had been undertaken.

Phosphate production was maintained at about the same rate as that of the previous year, output being achieved by working a different deposit.

Reserves at the oil deposit at Oued Gueterini are gradually being exhausted, but very promising results have been disclosed from prospecting operations carried out in the Sahara. Deposits at Tiguentourine and Hassi R'Mal have been developed. New indications of oil at Edjeleh and gas at Ahnet have been discovered; work has proceeded on exploitation at the Hassi Messaoud workings, a provisional rate of 1,200 tonnes per day being envisaged; the oil will be transported by pipe and normal routes to Touggourt.

The Bureau of Mineral Research has reported indications of diamonds and platinum at Hoggar.

Morocco

In Morocco the output of minerals taken as a whole, showed a slight increase on last year's figures.

Output of calcium phosphate in Morocco remained at a high level (nearly 6,000,000 tonnes). Anthracite mined from the North African coalfields showed an appreciable increase in production, but iron ore output was a little lower. There was a marked rise in the production of manganese and zinc ores, and the same tendency was observed in other metals, with the exception of cobalt.

Barytes output was lower, but a small quantity of strontium concentrates was produced in the Tirrhist district.

The extraction of crude oil is on the decline; the distilling works at Petitjean treated about 9,000 tonnes, of which part was imported crude oil.

Tunis

Tunis produced a limited quantity of natural gas at the Cap Bon concession; this gas was almost entirely consumed by the town of Tunis.

The Douaria group of iron mines were able to raise their output of iron ore but the main production still comes from the mines at Djerissa, which are responsible for four-fifths of the total. Great Britain was, as in previous years, the principal consumer for iron ore exported from Tunis.

There was a fall in the production of lead and zinc ores, which had been foreseen. No mercury was produced during 1957, but a distilling plant will be in commission at the Djebel Arja mine during 1958.

Work on the calcium phosphate plants had to be halted temporarily because of floods in November and December, which resulted in increased stocks and a decrease in production. France still heads the importers of Tunisian phosphate.

French West Africa

Iron ore production near Conakry is still rising, and is expected to increase further in the future.

Production at the bauxite deposit on the island of Kassa was maintained at a slightly lower rate, owing to the slackening in the export market. It is, however, estimated that production will soon be stepped up to its former level of 500,000 tonnes a year. Output of aluminium phosphate has again shown a slight increase.

There has been a marked fall in diamond production, at any rate in the output for which official statistics are available; it is, however, estimated that certain quantities are mined which do not show in the statistics.

Production of ilmenite and zircon has proceeded at a regular pace, and also that of cassiterite.

Exploitation of the mineral resources now proceeding in French West Africa should see further expansion, and should result in a considerable increase in the value of mined production in this territory in the next five years. The most important work being carried out by the mining industry is in the following areas:

In Senegal, treatment of the deposits of black sands for production of ilmenite, zircon and rutile; exploitation of the vast deposits of aluminium phosphate by the Péchiney Co., and preparatory work to enable the important deposit of calcium phosphate to be economically worked; research for oil.

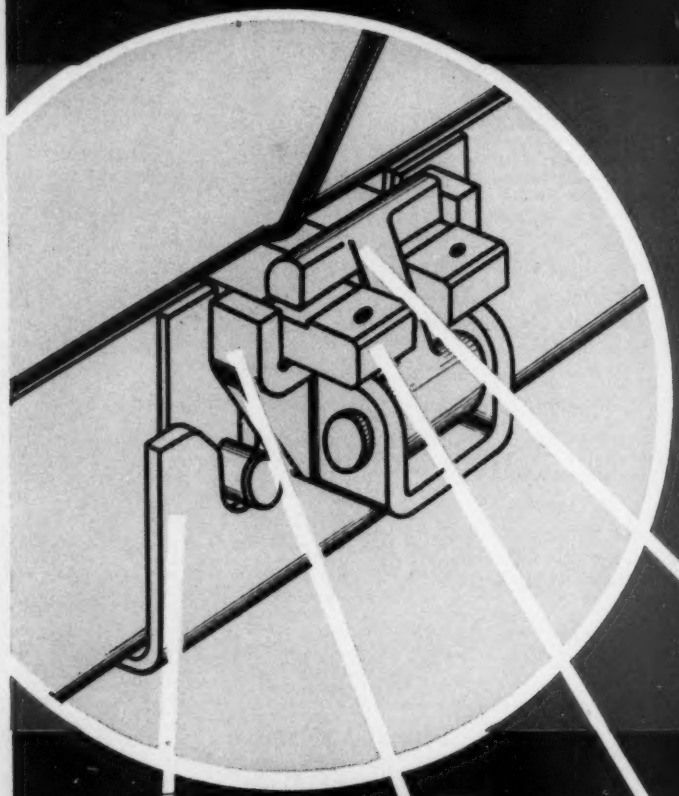
In Mauritania, reconnaissance work for exploitation in the very near future of an auriferous copper ore deposit, and a deposit of iron ore in the neighbourhood of Akjoujt by the Micuma Co. and of an iron

METAL and MINERAL OUTPUT
(in 000 tonnes except where otherwise stated)

	1956	1957
Algeria		
Crude oil	33.5	**13.3**
Iron ore	2,627.8	**2,790.2**
Pyrites	6.1	**18.8**
Lead (concentrates)	14.8	**15.1**
Zinc (concentrates)	54.1	**48.9**
Tunis		
Iron ore	1,168.9	**1,174.9**
Lead ore	38.8	**37.2**
Zinc ore	8.6	**6.6**
Lead metal	24.8	**24.6**
Calcium phosphate	2,076.8	**2,067.3**
Natural gas (000 cu. m.)	5,817.1	**6,020.1**
French Equatorial Africa		
Diamonds.....000 ct.	145.8	**109.2**
Lead (concentrates)	5.7	**3.5**
Gold.....kg.	1,266.0	**957.4**
Cameroons		
Gold.....kg.	14.4	**339.0**
Cassiterite (concentrates).....tonnes	122.9	**109**(a)
Rutile (concentrates) tonnes	151.9	**41.0**
French West Africa		
Iron ore	846.9	**1,090.0**
Bauxite	452.0	**385.0**
Ilmenite	20.1	**36**
Diamonds.....000 ct.	389.7	**250**(a)
Madagascar		
Graphite	14.4	**15.5**(a)
Mica	0.4	**1.0**(a)
Beryl, quartz and garnet	0.3	**0.7**(a)
Morocco (excluding Spanish zone):		
Coal	482.0	**521.0**
Crude oil	97.5	**75.1**
Iron ore	490.0	**468.0**
Manganese ore	415.0	**491.5**
Cobalt ore	6.4	**4.2**
Lead (concentrates)	120.0	**127.1**
Zinc (concentrates)	71.0	**88.9**
Barytes	29.6	**14.8**
Calcium phosphate	5,521.8	**5,567.5**
New Caledonia		
Nickel ore	1,239.0	**1,800.0**(a)
Chromite	48.9	**64.3**
Iron ore	28.1	**233.9**

(a) estimated.

THE COWLISHAW WALKER BUTT JOINT CONVEYOR



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ore deposit of 65 per cent content near Fort Gourand, by Miferma.

In Guinea, development of iron ore production, development of bauxite production in the islands of Los; investigations in the Eoke area; studies with a view to the fabrication of 400,000 tonnes of alumina annually, at the confluence of the Badi-Konkoure rivers, where the existence of hydro-electric resources near the bauxite deposits allow production at an annual rate of 150,000 tonnes of aluminium to be envisaged; exploitation of alluvial gold and diamond areas.

On the Ivory Coast, in Dahomey and in the Sudan, prospecting for diamonds, gold, manganese, chrome, hydrocarbons, etc., is being actively undertaken.

French Equatorial Africa

The chief mineral products of French Equatorial Africa consisted, as in previous years, of gold, diamonds and lead ore; oil is now also being produced.

In Gaboon, the deposits, as previously noted, are gradually becoming exhausted, and this has resulted in a perceptible fall in gold production. It has not been possible to make up for this decrease, even by further mechanization. When the position of known reserves is taken into account, the rate of production is expected to fall still further in future years.

The rate of diamond production has decreased in the same proportion to that of the fall in gold output (25 per cent compared with the 1956 figure); the reserves of high-grade ore in the Ouest-Oubangui deposits are being worked out. But important prospecting projects are being undertaken on higher ground, in order to compensate for the exhaustion of the placers now being exploited.

The output of cerusite concentrate, containing 52 per cent lead, also dropped, but it is hoped that this fall, though considerable, may be only a temporary one, since work on a new deposit is expected to start in 1958.

Exploitation of the oilfields at Pointe-Clairette and Ozouri started in 1957 (173,000 tonnes of crude); a new area is expected to begin production in 1958, which should step up output to an appreciable extent.

Work has begun on the establishment of communications for the transportation of manganese ore from the deposits of Moanda-Franceville, and output is expected to reach a level of 500,000 tonnes of marketable products by 1961. There is a small cassiterite mine in the Middle Congo, while exploitation of the wolfram deposit at Yedri (Tibesti) began in December, 1957.

French Cameroons

In French Cameroons the first aluminium ingot fabricated in Africa was poured at Alucam, on February 1, two years after putting the plant in hand. Production reached a level of 7,600 tonnes in 1957; when all the facilities at Edea, where expansion is in progress, are in full use, a regular rate of output of 45,000 tonnes per year should be achieved (probably in 1959).

Gold mining in Cameroons comes from a placer deposit of exceptionally high grade which, unfortunately, was almost worked out by the end of the year. Cassiterite is now being worked in offshoots, owing to the fall in grade of those zones which have previously been worked. Rutile mining has been discontinued owing to the drop in market prices.

Most prospecting work has been concerned with the search for oil, bauxite, iron ore and radioactive materials. Prospecting activities for oil and natural gas carried out at Logbaba are slowing down. As regards bauxite, the reserves at the Fongo-Tongo deposit are estimated at over 30,000,000 tonnes, with an alumina content of about 45 per cent.

Madagascar

Mining activity in Madagascar has been fairly well maintained in all sectors. While the price for graphite continues to fall, it has been found rather difficult to carry on production. With regard to mica, however, the situation has been very favourable, and production almost equalled the record figure for 1949—1,000 tonnes. Piezo-electric quartz suffered from Brazilian competition, but the production of industrial beryl increased noticeably, and should continue to advance as a result of the continued activity in prospecting and exploitation of pegmatites.

Work has been carried out to put the mining of thorianite and monazite in the neighbourhood of Fort-Dauphin on to an economic basis, and research is in process for the installation of a large treatment plant for radioactive sands. Oil prospecting is developing satisfactorily.

New Caledonia

The principal mineral output of New Caledonia is nickel ore, part of which is treated locally to obtain mattes and ferro-nickel. Chrome and iron ores are also mined. Prospecting and research work has been carried out on deposits of nickel, chrome (in rocks), manganese, cobalt (for which a washing plant has been constructed), copper, lead, zinc, coal and hydrocarbons.

The world shortage of nickel encouraged the upward trend, which had been checked in 1956, to continue until September, 1957, and production from New Caledonia reached a new record. During the year 1,150,000 tonnes of ore were exported, chiefly to Japan. However, a surplus of nickel appeared in world markets towards the last quarter of the year under review, and a serious fall is expected in 1958. With regard to the metallurgical processing of nickel in New Caledonia, which is sent to France, this has shown a slight increase, and the programme of expansion and modernization of plants has been carried on at a satisfactory pace.

Production of chrome ore increased by one-third, most of which was destined for U.S. consumption. Mining at the iron ore deposit at Prony by the Socamifer Co. resulted in an output of over 230,000 tonnes.

Efforts are being made to develop economic exploitation of magnesium carbonate (giobertite) in the Koumac region.

French Settlements in Oceania

Output of calcium phosphate was still on the increase, reaching a level in the neighbourhood of 300,000 tonnes.

French Guiana

In French Guiana production of gold from the only lode mine being worked was nearly double the previous year's output and it is hoped to double even this figure in about two years from now. Research work continues on another lode mine.

Mining of colombite-tantalite was brought to a halt during the year. The bauxite deposit which had previously been noted was the subject of an agreement, and it is hoped to commence extraction in 1963.

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Uranium, with nine mines now operating in Ontario, accounted for the major share of the increase. Total value of uranium oxide produced in 1957 was $78,235,359, as compared with only $9,361,867 in 1956.

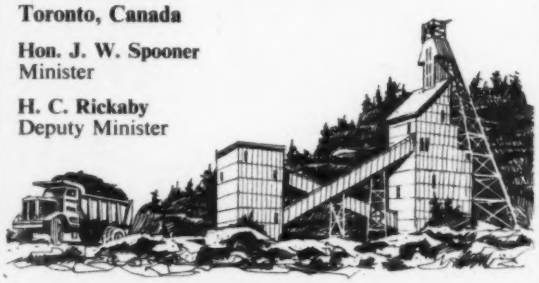
Ontario mined more than half of Canada's metallic minerals last year, increasing the provincial total by $74 million. Non-metallics were up by $2.5 million. Fuels were up by $2 million, and structural materials showed an increase of over $10 million.

For More Detailed Information, Write:

THE ONTARIO DEPARTMENT OF MINES
Toronto, Canada

Hon. J. W. Spooner
Minister

H. C. Rickaby
Deputy Minister



North America

CANADA • THE UNITED STATES • MEXICO • PANAMA

CANADA *By Our Own Correspondent*

THE year 1957 was one in which producers of minerals in Canada achieved new records in volume and value of output despite a series of price declines which, as the year drew to its end, was causing some anxiety about the future.

For the metals group as a whole the production value for 1957 was $1,136,000,000, which was slightly below the $1,146,000,000 recorded during the previous year. Nickel was the leading item with a value of $261,000,000, followed by copper at $199,000,000, iron $155,000,000, gold $148,000,000, uranium $131,000,000, zinc $99,000,000 and lead $52,000,000. Mineral fuels rose 7 per cent to a value of $555,000,000, the value of structural materials and industrial minerals rose by $22,000,000 to $444,000,000.

Exploration continued at a high level with geophysics playing a prominent role. Increasing attention is being given to the mineral potentialities of the North-West Territories.

The Provinces

As has been the case for many years, Ontario mineral production accounted for the largest part of Canada's mineral production, $739,000,000 or 35 per cent. Alberta, whose wealth depends, of course, on the petroleum industry, advanced slightly to $412,000,000 (19 per cent). Quebec stayed in third place with a value of $384,000,000 (18 per cent). British Columbia came fourth with $175,000,000, Saskatchewan with its rapidly advancing uranium and petroleum production was fifth with $161,000,000, followed by Newfoundland $76,000,000, Nova Scotia $65,000,000, Manitoba $61,000,000, New Brunswick $23,000,000, Northwest Territories $22,000,000 and Yukon $14,000,000.

Petroleum and Natural Gas

On balance the petroleum and natural gas industry had a favourable year during 1957 with the value of crude oil production reaching $444,800,000 and natural gas $20,800,000. Crude oil was Canada's leading mineral commodity with a production value $183,000,000 greater than nickel.

Exploration activity continued at record levels but development drilling was down 10 per cent from the 1956 peak. Gas pipeline construction had its greatest year with extensions of lines to eastern Canada and completion of lines in British Columbia.

Coal

Production of coal during 1957 was nearly 2,000,000 tons below that for 1956. This was due mainly to the expansion of the gas pipeline grid, which is introducing natural gas into the domestic and industrial market. Despite the severe loss of markets coal mining companies are striving to improve mining and coal preparation techniques and reduce costs.

Nickel and Copper

Production of nickel during 1957 reached a new high of 188,133 s.tons —approximately three-quarters of the Free World supply. For the first time in many years supply caught up to and passed the demand during the last few weeks of the year, mainly because the U.S. diverted nickel scheduled for shipment to the military stockpile to industrial markets.

Although this poses a major selling challenge to the big Canadian producers—International Nickel, Falconbridge and Sherritt Gordon — exploration and development continues at a high level of activity. In Manitoba Inco is preparing two large low-grade mines for production at a cost of $175,000,000 and a 9,000 tons concentrator and smelter will be built to achieve an annual production rate of 37,500 s.tons by the mid-1960's. Officials of the company are confident that by the time production is achieved new markets to absorb it will have been developed.

One new producer, North Rankin Nickel Mines, Ltd., came into operation in 1957 and B.C.'s first nickel producer, Western Nickel Mines, Ltd., was within a month of production status as the year ended.

The news regarding copper during 1957 was uniformly gloomy as producers and potential operations were hit by the continued weakness in markets. Production of copper ores totalled some 346,027 tons, 8,800 tons less than in 1956. The big producers, such as Inco, Noranda, Hudson Bay, Quemont, and others, have taken no steps to reduce output and new producers such as Geco and Willroy in Ontario, Cowichan Copper in B.C. and the Chibougamau mines of Quebec will all add their production of copper concentrate to the supply during 1958. Thus no change in the overall picture can be foreseen in spite of some closures such as Britannia and Granby in B.C., Rainville and Coldstream in Ontario, and Heath Steele in New Brunswick.

Cowichan Copper in B.C. joined the growing band of Canadian industries which is looking eastward by concluding a deal for the sale of copper concentrate to Japan.

Lead and Zinc

Mine output of lead during 1957 was 187,910 tons, approximately the same as 1956. Production from three areas which

METAL AND MINERAL PRODUCTION

	1955 (000's)	1956 (000's)	**1957 (000's)**
Antimony ..... lb.	2,021	2,140	**1,411**
Aluminium ..... tons	542	614	**565**
Asbestos ..... s.tons	1,063	1,038	**1,061**
Arsenious Oxide ..... lb.	1,571	2,624	**3,385**
Barytes ..... s.tons	254	321	**216**
Bismuth ..... lb.	266	286	**277**
Cadmium ..... lb.	1,919	2,339	**2,340**
Coal ..... s.tons	14,819	14,916	**13,183**
Cobalt ..... lb.	3,318	3,517	**3,736**
Copper ..... s.tons	326	355	**346**
Fluorspar ..... s.tons	128	140	**68**
Gold ..... oz.	4,542	4,383	**4,419**
Gypsum ..... s.tons	4,668	4,896	**4,501**
Iron ore ..... s.tons	16,283	22,348	**22,386**
Lead ..... s.tons	203	189	**183**
Mica ..... lb.	1,640	1,843	**1,427**
Molybdenite ..... lb.	1,389	1,404	**875**
Natural Gas ..... m. cu. ft.	150,772	169,612	**206,214**
Nickel ..... s.tons	175	178	**189**
Oil (crude) ..... bbl.	129,440	171,981	**181,562**
Platinum ..... oz.	170	151	**196**
Palladium, iridium, rhodium ..... oz.	214	163	**213**
Selenium ..... lb.	427	330	**352**
Silver ..... oz.	27,984	28,432	**30,138**
Tin ..... lb.	493	757	**809**
Titanium oxide ..... s.tons	117	157	**185**
Titanium ore ..... s.tons	1.4	2.3	**10.5**
Tungsten (WO_3) ..... lb.	1,943	2,271	**1,993**
Uranium ..... value	$26,031	$45,732	**$130,991**
Zinc ..... s.tons	433	423	**412**

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regularly account for 95 per cent of Canada's lead—B.C., Newfoundland and Yukon—was down but this was offset by the new production in the Province of New Brunswick.

The great Sullivan mine in B.C., owned by Cominco, again supplied the bulk of Canadian lead, and apart from closure of its open-pit, remained on much the same basis (10,000 tons daily) as before. Other mines were either forced to close or curtail operations. A notable event was the first production of lead in New Brunswick when the 1,500-ton operation of Heath Steele Mines, Ltd., started in February. However, as the year ended low prices threatened the future of this venture.

Some lead is also expected to be outlined in the considerable ore bodies now being developed by Hudson Bay Mining and Smelting Company at Snow Lake, Manitoba.

Value of zinc produced in Canada during 1957 was $99,696,301, a decline of 20 per cent from 1956, while production at 412,309 tons was some 10,000 tons down from the previous year. Main production was from the Sullivan mine in B.C. and the Flin Flon mines of Hudson Bay Mining and Smelting in Manitoba, but the new Geco and Willroy mines in Ontario, which have good zinc grade, will add materially to supplies during the coming year.

As in the case of lead, first production of zinc in New Brunswick was achieved when Heath Steel Mines, Ltd., went into operation in February.

Production in Quebec, Newfoundland and Yukon was continued at a steady rate.

Iron Ore

Iron ore shipments by Canadian producers in 1957 increased to 19,988,383 l.tons from 19,953,820 l.tons. during 1956. This was an all-time high and though a reduction in production rate was setting in at the end of the year, signifying a lower output in 1958, the outlook is for an output of between 46,000,000 and 60,000,000 tons by 1965.

Value of production during the year was $155,549,111.

Production from the major operations continued at a high level and good progress was made on potential producers. The most spectacular of these, Caland Ore Company, which is draining a 12-mile-long lake before starting stripping operations, expects to be producing within two years. This operation was the object of awe when visited by delegates to the Sixth Commonwealth Mining and Metallurgical Congress last autumn. In the Ungava area, where huge tonnages have been indicated, discussions for their development have taken place with West German interests.

In British Columbia—where a new iron property, Empire Development, Ltd., started operations—the future of the iron ore mining section of the industry was clouded by the provisions of the Mineral Property Tax which imposes special taxes on iron ore properties amounting to $1 a ton. A potential producer is Cominco which, in its large accumulation of pyrrhotite tailings at Chapman Camp, B.C., is studying the feasibility of producing pig iron and steel.

Uranium

Thirteen new mines and nine new processing plants brought into production during 1957 made the uranium mining situation in Canada by far the brightest achievement during the year as far as the mineral industries were concerned. A total of 23,500 tons per day processing capacity was added by new plants and in addition some plants expanded their capacity, total designed milling capacity at the year's end being 33,300 tons daily.

During the year production of uranium oxide reached 13,374,800 lb. valued at $135,985,000, a sharp and encouraging increase from 1956 production which was 4,581,060 lb. valued at $45,732,145.

The Blind River area emerged during the year as Canada's largest uranium-producing field with six new producers. In all there will be eleven major uranium mines in this area by the end of the current year.

Other mines reaching production status during 1957 were Rayrock Mines, Ltd., in the Northwest Territories; Lorado Uranium Mines, Ltd., in Saskatchewan which is also treating customs ore from five nearby properties; Bicroft Uranium Mines, Ltd., Faraday Uranium Mines, Ltd., and Canadian Dynox Mines, Ltd., in the Bancroft area of Ontario.

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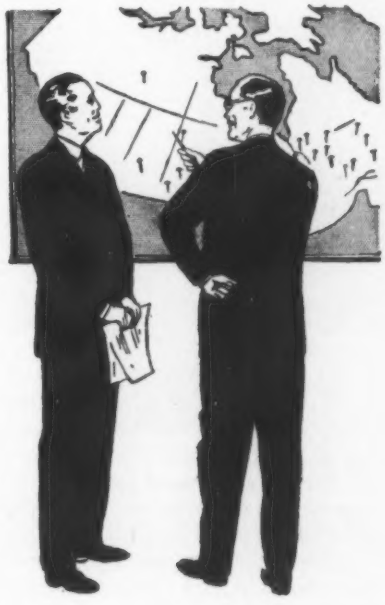

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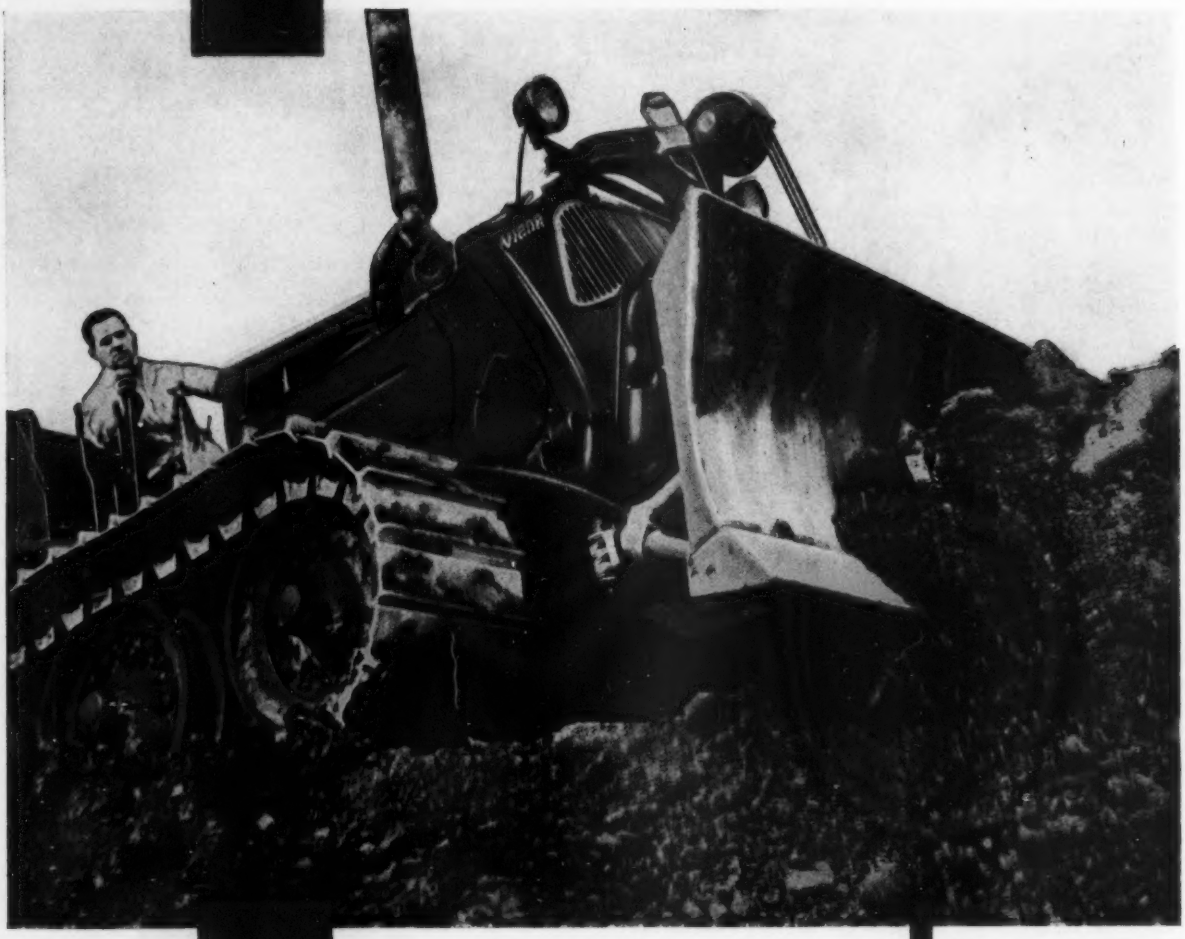

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Adolf Morath, famous photographer of machines and men, took this colour photo on a visit to Cockles Park Open Cast Coal site, Northumberland, England, where a number of Vickers Vigor tractors and Vickers Onions scrapers are at work. The contractors – Dowsett Engineering Construction Ltd.–plan for a total excavation of 11,500,000 cubic yards of earth.
The picture was taken at f/8 1/50 second on Agfa negative colour film.

It is expected that value of production in 1958 will reach the figure of $300,000,000.

Silver and Gold

Although not occupying much of the spotlight, silver production continued to make a worthwhile contribution to the value of Canadian minerals in 1957 with an output of 30,138,447 ounces compared with 28,431,847 ounces in 1956. Value of production was $26,319,907.

Since prices on the open market were generally stable, and since to a large degree, Canada's silver is derived as a by-product of base-metal mining, revenue from this source is a much-appreciated sweetener for harassed lead and zinc operators. Leading producers were United Keno Hill Mines, Ltd., in Yukon, Cominco and Torbrit Silver Mines, in B.C.

The adverse conditions that faced the gold mining industry, including a fixed price for its product in the face of rising prices, and an adverse exchange rate on the Canadian dollar, did not abate appreciably in 1957, but some relief was felt in the latter part of the year when the Canadian dollar edged closer to parity with the U.S. dollar to give producers a return of $34.42 per ounce of gold.

Total production, including by-product gold, was 4,436,101 ozs. valued at $148,786,827 which compares with final production figures for 1956 of 4,383,863 ozs. valued at $151,024,080.

As the year drew to a close the outlook for the gold mining industry was somewhat brighter particularly in respect to availability of labour, which became more plentiful with the slowdown in base metal activity. Another bright spot was the development of higher-grade gold at depth in the Red Lake camp of Ontario and at the Bralorne mine in B.C.

The French mine of Cariboo Gold Quartz Mining Company started operating on a 40-ton basis in August. Ontario continued to be the leading producer of gold, accounting for more than half the Canadian production.

Asbestos

Demand for asbestos continued at high levels during the year and Canadian producers reported shipments for the third successive year of over 1,000,000 tons with an all-time record value of $106,000,000. In 1958 asbestos production will rise by a further 15 per cent as three new mines come into production.

An interesting development was the fact that for the first time Canadian shippers were experiencing strong competition from African and Russian chrysotile in Western Europe.

The year 1957 was characterized by aggressive search for new asbestos deposits and promising properties are being developed in northern British Columbia, Yukon and Newfoundland.

Industrial Minerals

Industrial minerals in Canada, including structural materials, were produced to the value of $442,029,585 during 1957. This was the thirteenth successive record since 1945 and exceeded the 1956 record by $22,000,000.

Considerable attention was focused during the year on the progress being made to bring the deep potash beds of Saskatchewan into production. At the close of the year seventeen different companies held land along the potash belt and two, International Minerals and Chemical Corporation (Canada) Ltd., and Potash Company of America are sinking shafts and building plants to process the potash for industrial use.

A great increase in output of elemental sulphur was recorded during the year when production reached about 100,000 tons compared with something less than 35,000 tons in 1956. This was recovered mainly from natural gas in Western Canada. It is expected that this will increase to possibly 1,000,000 tons during the next few years.

Among other prominent minerals barytes declined to 216,325 tons from 320,835 tons; fluorspar dropped to 68,463 tons from 140,071 tons; gypsum dropped from 4,500,664 tons to 4,100,000 tons; lime increased to 1,379,871 tons; and nepheline syenite increased to 202,942 tons, a new record. Latest addition to the list of minerals produced in Canada is lithium. In 1957 shipments from Quebec Lithium Corporation amounted to 5,373,000 lbs. with a value of $2,955,150.

The Outlook

Canada, vast storehouse of mineral wealth, has again passed through a year which was notable for the remarkable output of metals and minerals of all kinds. As the year ended, however, operators were worried because of the economic decline in Canada and the U.S., which threatened to spread, bringing with it the possibility of import quotas or higher tariffs.

Existing surpluses in copper, lead, zinc, iron and nickel will change again to shortages as populations grow and standards of living rise. The world, it is felt, will need these metals and with them the new metals and minerals—lithium, uranium, molybdenum, columbium, cobalt and the others. Nevertheless, in Canada it is recognized that the mining industry is experiencing, and will probably continue to experience for another year or so, a downturn. Prices of base metals will continue low during 1958 and lower steel mill operations will affect the demand for iron ore. Offsetting this will be a substantial gain in the tonnage and value of uranium and asbestos and also gold.

In general, however, 1958 will not be an easy year and operators are watching operational and development costs closely as they edge towards the red ink line. It will be a year of continued activity in exploration, of consolidation in operations, and of watchful waiting as signs of renewed activity are sought.

For the long-term there is nothing but optimism and when the upturn comes, as it will, Canadian mining men have never been better equipped to meet the challenge.

THE UNITED STATES

MINERAL output in the U.S. attained a record value of $18,300,000,000 in 1957, a gain of more than $750,000,000 over 1956, according to the Bureau of Mines' U.S. Department of the Interior. The 1956 value was $17,500,000,000.

Last year's increase was due almost entirely to higher values for the mineral fuels, particularly crude oil and natural gas, which were large enough to offset declines in production for most other minerals as well as sharp drops in base-metal prices. Natural gas and iron ore were the only major commodities to show sizeable production increases.

Anthracite, cement, gypsum, phosphate rock, bauxite, chromite, and tungsten all declined in both production and value. In contrast, helium, barite, diatomite, cobalt, mercury, ilmenite, and uranium ore all registered substantial production and value gains.

Fuels had an overall gain of 8.7 per cent in value, compared with an increase of 1.6 per cent for other non-metallics and a decrease of 11.6 per cent for metals.

The value of gold output, estimated at $62,000,000, was the lowest since 1945.

The values of uranium-ore production, estimated by the Bureau at nearly $75,000,000 in 1957 and $63,000,000 in 1956, are included in the totals for the first time.

The year was a difficult one for many mineral-producing industries. The Suez Canal closure crisis extended well into 1957 and contributed to a major dislocation in petroleum production, transportation, and inventory patterns. Reduction in stockpile purchases, declining consumer demand, and a lessening of agricultural barter transactions combined to force lead and zinc prices downward. Copper prices continued to fall from the 90-year high of 46 c. in February, 1956 to 32 c. only a year later and to 27 c. by September, 1957.

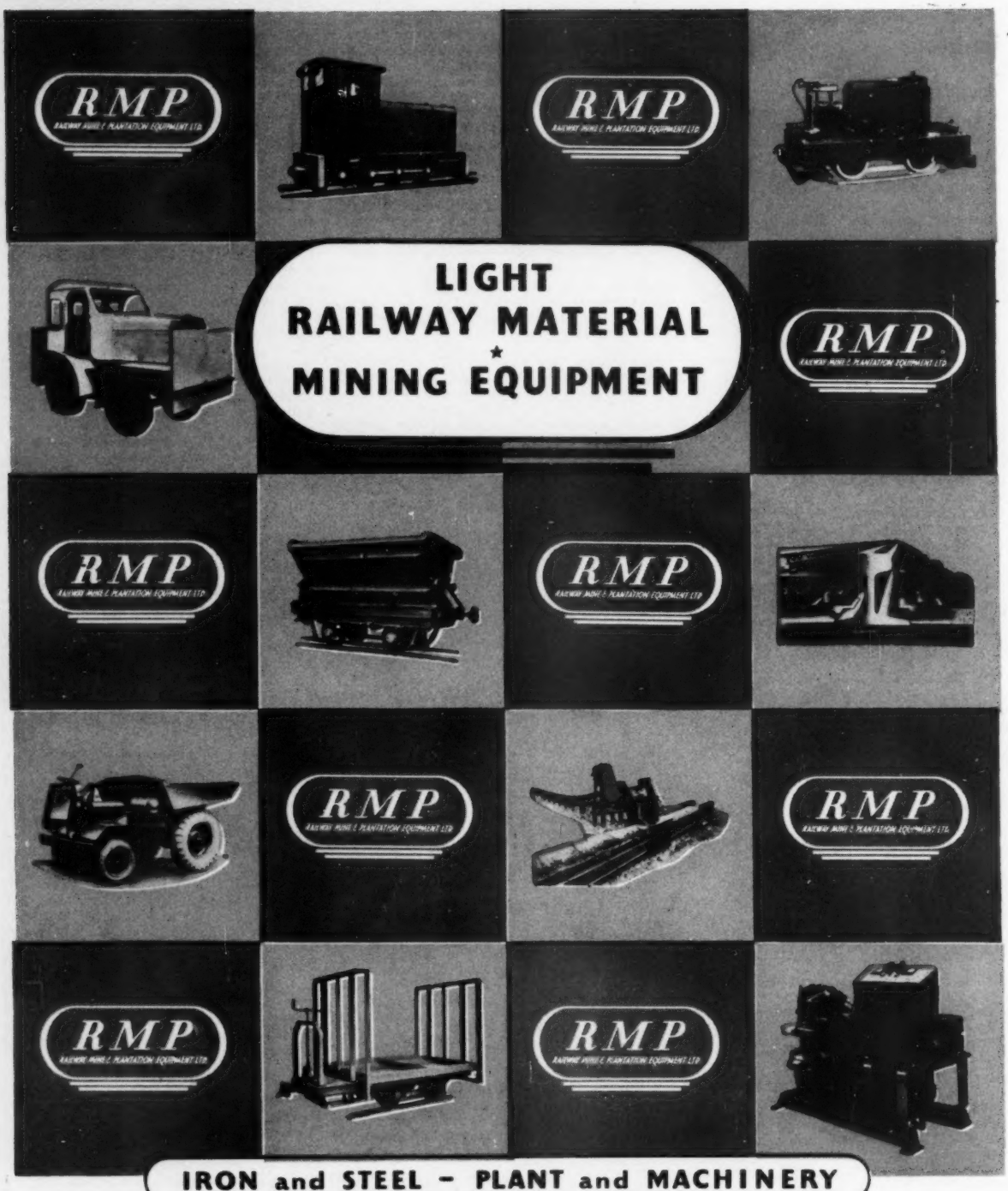
Coal, Oil and Gas

Bituminous coal and lignite production in 1957, estimated at 490,000,000 tons, was down 2.2 per cent from the 501,000,000 s.tons* produced in 1956, because of decreased domestic consumption. The general outlook was for continued decline in production, the extent of which will be measured principally by whatever reduction there may be in the volume of exports in 1958.

The average value of soft coal at the mine was estimated at $5.10 a ton, compared with $4.82 in 1956.

Pennsylvania anthracite production in 1957 resumed its post World War II downward trend, following a rise in 1956. Output is estimated to have fallen off approximately 12 per cent to 25,500,000 net tons valued at $212,000,000. Since the European export market remained virtually the same, the drop in production can be attributed to the decrease in demand in domestic consumption and in shipments to Canada.

*S. tons have been used throughout unless otherwise stated.



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The estimated production rate of crude petroleum in 1957 was 7,153,000 bbl. daily, an increase of 2,000 bbl. a day over 1956. Total crude output for 1957 amounted to 2,611,000,000 bbl.

Natural gas production is estimated to have held unchanged in 1957 at 138,000,000 bbl. Marketed production of natural gas continued its steady increase, reaching an estimated 10,688,000,000 cu. ft.

Uranium

Production of domestic uranium concentrate was at the rate of nearly 10,000 tons of uranium oxide a year, compared with about 6,000 tons in 1956, and is expected to rise to 15,000 tons or more in 1959.

Fourteen uranium mills, with an aggregate capacity of 10,000 tons of ore a day, were in production in the U.S. at the end of 1957. At least five of these mills employed the solvent extraction method of processing uranium developed by the Bureau of Mines, and four mills currently proposed or under construction are expected to utilize the Bureau method.

The Atomic Energy Commission announced in October that uranium deliveries under its procurement programme appeared adequate for military and power requirements for the next several years. The Commission stated that the immediate objective of the uranium programme was to keep production and requirements in reasonable balance, the long-range problem being to develop additional ore reserves.

At least 10 nuclear-power reactors and 39 research and test reactors were operating in the U.S. in 1957. In addition, 123 power or research reactors were being constructed or had been contracted for by American firms, some for installation overseas. The first non-military reactor to produce electric power for commercial distribution in the U.S. was completed and two nuclear-powered submarines were in operation.

Aluminium, Magnesium and Titanium

Primary aluminium production in 1957 was 1,650,000 tons, approximately the same as in 1956. By the end of the year installed capacity for the production of primary aluminium in the U.S. was 1,840,000 annual tons, an increase of 63,000 tons during the year. This was due to activation of two potlines at Kaiser Aluminum and Chemical Corp. plants, one of these being the first potline to go into production at the new Ravenswood, W. Va., facility. Major reduction installations were under construction by the Aluminum Co. of America, Harvey Aluminium Co., and the Ormet Corp. Reynolds Metals Co. announced plans for a 100,000-ton annual capacity primary aluminium plant at Massena, N.Y.

With aluminium in more ample supply, three primary producers—Alcoa, Kaiser, and Reynolds—exercised their rights to sell metal to the Government under expansion contracts negotiated during the Korean War. By the end of the year more than 200,000 tons of metal had been shipped to Government stocks.

Wage rises and cost increases in materials, transportation, and selling resulted in a 1 per cent rise for primary ingot in August, bringing the metal to 28.1 c. per lb.

Domestic output of bauxite in 1957 was estimated at 1,500,000 l. dry tons, a 14 per cent drop from 1956. U.S. production in 1957 accounted for an estimated 18 per cent of the total new supply for consumption, compared with 23 per cent in 1956. Imports of bauxite are estimated at 6,700,000 l. dry tons, an increase of 18 per cent over 1956. Part of the increase is credited to the Government's programme for purchasing Jamaican bauxite for stockpiling and the building of stocks by industry for use at the new alumina plants scheduled to be in production in 1958.

Magnesium was the only structural metal obtained almost wholly from sea water in the U.S. Primary production rose to 81,000 tons in 1957, being 17 per cent higher than in 1956, when it amounted to 68,346 tons.

Output of 5,900,000 tons of magnesite and dolomite for basic refractories in 1957 reflected a rise of 11 per cent in demands by the iron and steel industry.

The titanium sponge metal industry operated at a record high level during the first quarter of 1957, after which, production and consumption rates fell off due to a reduction in military requirements. Nevertheless, the U.S. Bureau of Mines estimates that 1957 output exceeded 1956 by 20 per cent, totalling about 17,500 tons. Sponge consumption was about 20 per cent below 1956, dropping to an estimated 8,500 tons. The military cutback of titanium use was reportedly due to reduced orders for aircraft and a stretch-out of deliveries. Despite this development, producers reduced the Grade A-1 sponge price from $2.75 to $2.25 and dropped average mill products prices by 10 per cent.

Domestic ilmenite production increased markedly to achieve a new high estimated at 710,000 tons. Rutile output remained near the 1956 level of 12,000 tons. Ilmenite imports, including titanium slag, were 352,488 tons during the first nine months of the year, being a 32 per cent increase over the corresponding period in 1956. Imports of rutile in the first nine months were 66,083 tons, exceeding receipts in the previous year by 76 per cent and setting a new record.

Because of the increase in production of titanium sponge metal, consumption of rutile in 1957 was probably greater than 1956. However, ilmenite consumption was undoubtedly lower due to an estimated downturn in output of titanium dioxide pigments for which most of the ilmenite is used. Production and shipments of titanium pigments, based on titanium dioxide content, were expected to be down 6 and 7 per cent, respectively, from the high level established in 1956, but they were still greater than in any other year.

Copper

Production of recoverable copper from domestic mines decreased nearly 5 per cent from 1956; refinery output remained about the same and consumption of refined copper fell approximately 15 per cent. Total imports of copper rose about 6 per cent and exports of refined copper almost doubled. Stocks of refined copper increased nearly 65 per cent.

Continuing imbalance between supply and demand for copper in 1957 forced the price of electrolytic copper produced domestically from the year-opening quotation of 36 c. per lb. to 27 c. by early September. The 36 c. quotation established on October 29, 1956, held until February 1, 1957; then four successive drops lowered it to 32 c. by February 19. Further cuts in June, August, and early September brought it to 27 c. Prices quoted by U.S. custom smelters were 1 to 2 c. lower, and foreign market prices were as much as 4 c. per lb. lower. The frequent price cuts and the announced curtailments of production failed to encourage the increase in demand needed to stabilize or spark an upturn in the market.

Iron and Steel

The nation's iron-ore supply in 1957 was the largest in history. Preliminary estimates indicate that domestic mines produced over 105,000,000 l.tons of usable iron ore and that imports totalled close to 34,000,000 l.tons. All mining districts contributed to increased iron ore production and the total from mines in the western district was a record high. The value of domestic output in 1957 was about 10 per cent higher than in 1956.

The U.S. Bureau of Mines expects the lower demand for steel during the last half of 1957, to hold production of the metal slightly below the 115,200,000 l.tons produced in 1956. Pig-iron output will exceed the 1955 record of 76,800,000 tons because the operating rate of open-hearth furnaces which utilize proportionately more pig-iron than scrap, did not decline as much as electric and cupola furnaces which use up to a 100 per cent scrap charge.

Ferroalloy Metals

Manganese ore production in the U.S. for 1957 was at approximately the same rate as

MINERAL PRODUCTION

		1955	1956	1957
Usable Iron ore	l.tons	103,000,000	98,000,000	**105,000,000**
Aluminium*	s.tons	1,566,000	1,679,000	**1,648,000**
Magnesium	s.tons	61,000	68,000	**81,000**
Manganese ore†	s.tons	287,000	345,000	**365,000**
Chromite ore	s.tons	153,000	162,000	**165,000**
Molybdenum	s.tons	31,000	29,000	**30,000**
Tungsten	s.tons	7,920	7,380	**3,770**
Copper	s.tons	999,000	1,106,000	**1,077,000**
Lead	s.tons	338,000	353,000	**333,000**
Zinc	s.tons	515,000	542,000	**520,000**
Uranium ore	s.tons	‡840,000	3,000,000	**3,700,000**
Mercury	flasks	19,000	24,000	**33,000**
Gold	f.oz.	1,880,000	1,832,000	**1,769,000**
Silver	f.oz.	37,198,000	38,948,000	**37,895,000**

* Plant production mostly from imported bauxite.
† 35 per cent or better.
‡ Last 6 months

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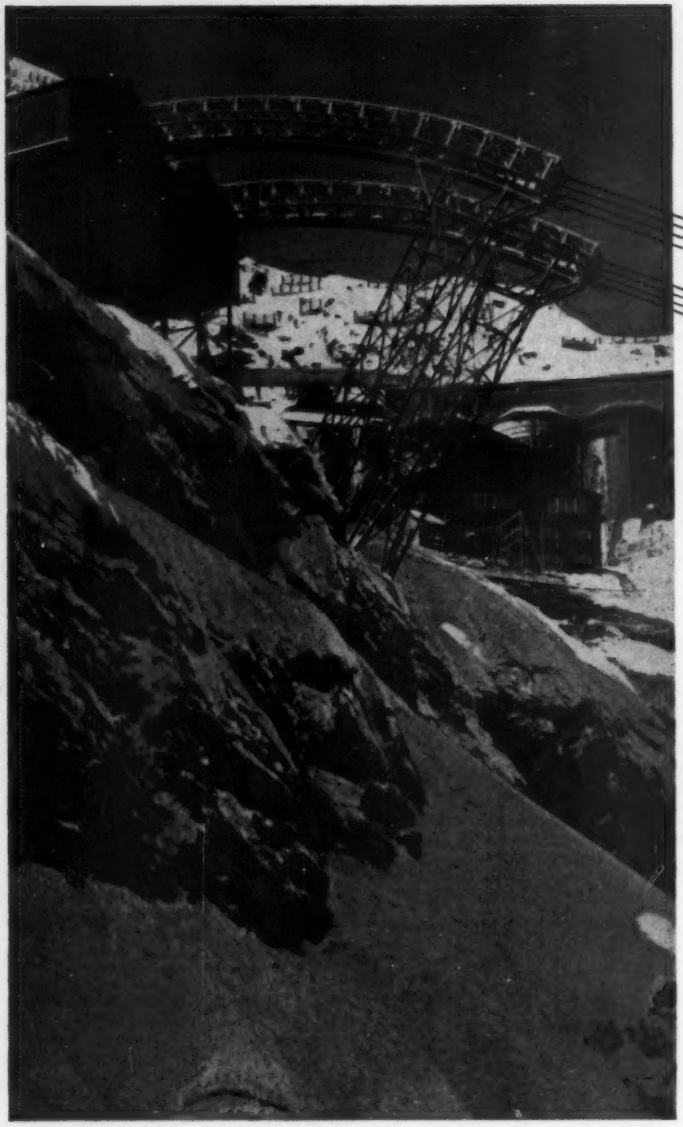

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for the previous year, but rates of imports and consumption were both noticeably higher. The beginning in January of regular shipments of high-quality ore, in quantity, from the Amapa deposits of Brazil was the most significant development of the year.

Domestic production (shipments) of chromite in 1957 was about 25 per cent below 1956, due largely to completion of the programme to upgrade low-grade ore and concentrate produced in Oregon during World War II. Industry stocks of both chromite and chromium products mounted during the year. Imports and domestic production of chromite were both estimated to have declined about 5 per cent.

The supply-demand position of nickel for civilian needs in 1957 was much improved over 1956 because virtually all scheduled shipments to the national strategic stockpile were diverted to industry. Due to the improved supply position, stocks (24,000 tons) held by consumers on September 30 were 89 per cent greater than at the beginning of the year. Domestic production of recoverable nickel increased about 3 per cent to 9,000 tons in 1957, but equalled only 7 per cent of consumption, which at about 128,000 tons held the 1956 level. Imports are estimated at 150,000 tons in 1957, up 5 per cent from 1956.

Government purchase of domestic tungsten concentrate, suspended in December of 1956, was not resumed in 1957 because funds were not provided. Domestic production through June was equal to about 60 per cent of the half-year output of 1955 and 1956, but accumulating stocks and falling prices forced closure of all except four or five mines by December. Total production for the year was 3,650 tons of contained tungsten (458,000 ton units of tungsten trioxide), equivalent to about 50 per cent of the preceding year's output. Value of domestic production, because of lower prices and lower output, was estimated at $12,800,000, only about 25 per cent of the 1956 value. In industry and Government, emphasis was given to research on producing ultra-pure tungsten metal in search of materials for high-temperature applications.

Domestic production of molybdenum grew in 1957, but shipments of concentrate decreased compared with the previous year. Consumption of concentrate dropped, but exports were higher than in 1956.

Rare Metals

Foreign output of columbium-tantalum mineral concentrates is estimated to have fallen 38 per cent in 1957, due to the suspension of U.S. Government purchasing of foreign ores for the stockpile. Domestic ore production is estimated to have tripled as the Porter Bros. Corp., placer operation in Bear Valley, Idaho, gained momentum. Domestic production facilities continued to expand. Wah Chang Corp. and Electro Metallurgical Co. began commercial production of pure tantalum and columbium. A new Fansteel Metallurgical Corp. plant at Muskogee, Okla., began operating during the year. The price of columbium, quoted nominally at $120 per lb. on January 1, 1957, dropped to a new low level when Electro Metallurgical Co. quoted list prices ranging from $55 to $85 per lb. in October.

U.S. beryl production in 1957 is estimated at 460 tons, being the same as 1956. Up to the end of September, 1,581 tons of domestic beryl had been purchased for the national stockpile through the domestic beryl purchase programme. The Defence Minerals Exploration Administration continued to encourage exploration for beryl. Both producers of beryllium completed new facilities to make reactor-grade metal for the Atomic Energy Commission. The Beryllium Corp. of Reading, Pa., built a plant at Hazelton, Pa., and the Brush Beryllium Co. constructed one at Elmore, Ohio.

Germanium made important advances in the electronics field in 1957 as wider applications of germanium transistors were introduced by industry. The supply of domestic germanium, plus imports, was adequate to meet the increased demand for the metal. Improved processing techniques sharply reduced the quantity of germanium required for each transistor and further reductions were anticipated with the announcement in November of the successful adoption of germanium in printed circuits.

Domestic consumption of the rare-earth metals for 1957 is estimated at 3,500 tons of rare-earth oxide, being approximately unchanged from 1956. Surplus quantities were available largely as a by-product in the processing of monazite for thorium. Domestic monazite production was from Florida and South Carolina, euxenite was produced in Idaho, and bastnasite was produced in California. Interest in the heavier rare-earth metals created a demand for those minerals containing higher proportions of the yttrium sub-group of the rare-earth metals, such as yttrofluorite, gadolinite, samarskite, and xenotime. Output of oxides and other compounds of the individual rare-earth metals, while still measured in grammes and pounds, increased significantly and the greater demand led to lower prices. Gadolinium, europium, and dysprosium were used experimentally as neutron absorbers in nuclear reactors, while the yttrium sub-group, particularly yttrium, gadolinium, and erbium, found applications in electronic devices.

Shipments of selenium fell off sharply during 1957, but production continued at a near record pace. As a result, producer stocks steadily climbed to an all-time high. Two major price decreases during the year failed to ease buyer resistance. Imports declined and quantity controls were removed from exports during the year. The use of selenium in rectifiers and other electronic applications continued to absorb more than half the metal consumed in 1957.

The four major producers of zirconium metal (Carborundum Metals Co., Columbia-National Corp., U.S. Industrial Chemicals Co., and the Wah Chang Corp.) began building production towards an average contract quantity of 1,250 tons a year. Capacity in excess of this figure has been installed to provide for demand for high-purity metal for private reactor construction, and for commercial-grade metal for non-reactor use. Kennecott Copper Corp. was constructing a test plant to make zirconium and hafnium by the Horizons electrolytic process. Despite the increased demand for zircon for metal production, total 1957 shipments of zircon were predicted to be less than in 1956, due principally to reduced demand from the foundry trade. Brazilian Government export regulations almost stopped the trade in zircon-bearing ores from Brazil. Enough hafnium was produced as a zirconium by-product to permit some sale to private purchasers.

Lead and Zinc

Both mine production and commercial consumption of lead declined about 5 per cent in 1957. Zinc mine production dropped by about 6 per cent, and consumption by about 8 per cent. The values of the lead and zinc mine output declined around 11 and 20 per cent, respectively. Imports of both metals were estimated to have exceeded the high levels of 1956.

Up to the end of April, domestic mine production and imports of lead and zinc were at higher rates than in 1956. In these four months smelter stocks of refined lead increased 35 per cent and zinc stocks rose 58 per cent. Early in May the prices of both metals, which had been stabilized for 16 months by good commercial demand and Government acquisitions for the national stockpile, began to fall. The price of lead dropped from 16 c. per lb., New York, to 13.5 c. per by October 14 and that of zinc, Prime Western grade, East St. Louis, dropped from 13.5 c. to 10 c. per lb. by July 1. Many mines were closed and others curtailed production. In September, output of recoverable lead hit the lowest level in nine years and that of zinc was the lowest recorded since the U.S. Bureau of Mines began reporting monthly mine production in 1941.

The Government continued to purchase domestically produced lead and zinc on a monthly basis for the national stockpile throughout 1957. The Government barter programme, under which foreign lead and zinc were acquired for the supplemental stockpile, was greatly restricted at the end of April. On September 27 the Emergency Lead and Zinc Committee, representing the lead and zinc industry, filed a petition with the Tariff Commission asking for relief under the "escape clause" provisions of the Trade Agreements Extension Act of 1951.

Quicksilver

The output of 31,000 flasks of mercury at domestic mines was the highest in any peacetime year since 1904. Production rose for the seventh consecutive year and surpassed 1956 by nearly 30 per cent. Significant gains in Alaska, California, and Oregon more than offset declines in Idaho and Nevada. Industrial consumption remained high and exceeded slightly the 54,000 flasks of the preceding year. General imports dropped sharply in the last half of the year to fall more than 15 per cent below the 52,000 flasks imported in 1956. Despite a constant quotation of $255-$257 a flask during the first six months, the decline in price after June was sufficient to force the average price 5 per cent below 1956.

Gold

Domestic production of both gold and and silver is estimated to have declined moderately in 1957, reflecting, principally, lower production of base-metal ores yielding by-product gold and silver. Output from straight gold mines continued to decline as several operations were forced to close due to rising costs and ore depletion. Total 1957 gold production was estimated at $62,000,000, smallest in 12 years, and silver at $34,700,000.

Non-Metals

Due to the decline of residential construction, the production of gypsum and gypsum products was lower in 1957 than in 1956. There was a decrease of about 14 per cent in quantity of domestic crude gypsum mined during the year and imports also dropped. Several new gypsum products plants began operating.

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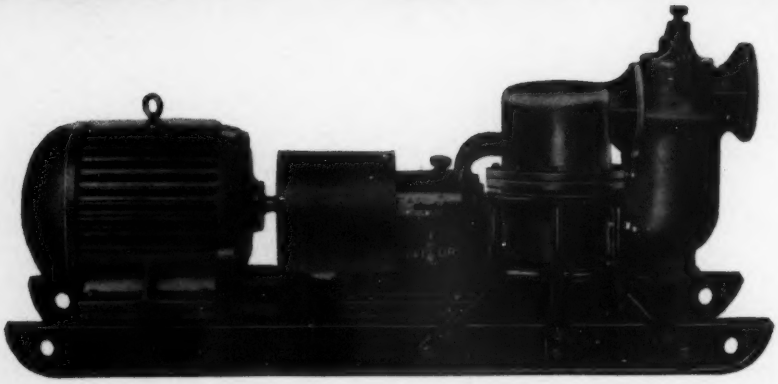

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An increased demand for kyanite concentrate in mullite refractories and for crude kyanite ore in special refractories contributed to a rise of about 5 per cent in the domestic production of kyanite, compared with 1956.

Stepped-up demand for feldspar by the glass-container industry was partly offset by decreased demand in pottery, but the total production was at a higher level than in 1956.

Output of sheet mica was expected to have dropped appreciably as substitutes continued to reduce the demand for the lower qualities of mica used in electrical appliances. Scrap mica production continued at nearly the 1956 level to meet demands for ground mica, principally in the building industries.

Phosphate rock production was less than in 1956 when producers were rebuilding depleted stocks. Total sales of phosphate rock remained about the same as in the previous year. A new phosphate-rock field was reported in Beaufort County, N.C., and the Bear Creek Mining Co. was exploring the deposits. Investigations of the Lower California phosphates continued.

Potash production continued its upward trend and the sixth major producer in New Mexico, the National Potash, began operations during the year. Development of the Canadian potash deposits continued throughout the year.

Domestic talc production decreased slightly due to lower demand for ceramic floor and wall tile.

Production and shipments of fluorspar in 1957 remained about equal to those of 1956. However, imports established a new record and consumption also gained. Shipments of acid grade increased whereas metallurgical grade declined somewhat. The Government purchase programme for acid and metallurgical grades continued throughout the year.

An indication of major changes taking place in the sulphur industry was the price cut announced in September. Output in the U.S. was lower than in the previous year and stocks increased. Imports rose as substantial tonnages from new mines in Mexico moved into the American market.

There was a notable growth in capacity for the production and consumption of boron minerals and compounds. Of major interest to the industry were developments in the use of boron in jet-plane and rocket fuels. Construction of facilities for the production of sodium borohydride at Beverly, Mass., decaborane at Henderson, Nev., boron-based fuels at Niagara Falls, N.Y., and high-energy boron compounds at Muskogee, Okla., reflected the importance of the exotic boron-based fuels. To supply the growing market for boron minerals, the U.S. Borax and Chemical Corp. expanded both its mining and processing facilities at Boron, California.

Barytes production and imports mounted to meet growing demand. Oil and gas well drilling was again the principal market for barytes, but increases were noted in other uses, including that as concrete aggregate for high-density concrete.

Production of asbestos was maintained in 1957 at about the same rate as 1956. A Government programme for purchasing asbestos from domestic mines was in effect throughout the year.

The Outlook

At the time of writing the predicted recovery in the U.S. economy has yet to materialize, but an improvement by late summer appears to be anticipated by the Government's economic advisers and by many leading industrialists. "Pump priming" measures include easier credit and cheaper money and the injection of new Government spending into the economy to the extent of some $2,000,000,000 per annum.

Though some mining companies have reduced or suspended their exploration activities, most of the larger undertakings show their confidence in the long-term future by continuing to carry out extensive air and surface prospecting, which is by no means confined to the U.S.

MEXICO

FALLING prices in the world markets for lead, copper and zinc have had serious effects in Mexico. Nacional Financiera reported that in the first eight months of 1957 the value of Mexican mineral production declined by about 100,000,000 pesetas as compared with the same period of 1956, although output was 11.3 per cent higher. The production of lead, zinc and copper would have been worth 600,000,000 pesetas more at the prices current in 1956. Concern is felt at the threat of increased duties on U.S. imports of lead and zinc. In this connection it is noteworthy that U.S. investments in the mining and smelting industry in Mexico accounted for output valued at over $200,000,000 in 1955 and produced the bulk of Mexico's exports of metals and minerals, other than petroleum.

After long negotiations with the Mexican Government, the Mazapil Copper Co. is to receive "economic aid" in the form of certain refunds of export and production taxes. This aid is applicable in the first place to cover losses on copper mining, with any available surplus to be applied against expenditure on the expansion programme. This programme includes an increase in the scale of operations on a new sulphide orebody at Cata Arrovo and a new flotation mill will be constructed to handle 1,000 tons a day.

San Francisco Mines of Mexico reported continued satisfactory results from development on the recently discovered veins near the North Shaft of the Frisco mine. Further improvements in mill metallurgy were made during the year.

Exploration and development work is under way at the silver-lead-copper mine of Compania Minera Matamoros S.A., in the State of Puebla.

OUTPUT OF PRINCIPAL MINERALS

	1956	1957
Gold ..... f.oz.	347,000	**350,000***
Silver ..... f.oz.	43,100,000	**46,000,000***
Copper ....l.tons	59,175	**58,041**
Zinc ..... l.tons	245,000	**240,000***
Lead .....l.tons	196,000	**196,000***

* Estimated recoverable

A monthly production of about 2,500 tons of crude ore is expected by April, 1959 from the Dowa Mining Co., founded in 1955 to develop a copper mine in Mexico.

The Mexican sulphur industry continues to forge ahead and is to be further expanded. Output rose from 775,000 s.tons in 1956 to about 1,000,000 tons in 1957 and is expected to be still higher in 1958. The two U.S. companies responsible for the bulk of Mexican exports—Pan American Sulphur Co. and the Gulf Sulphur Corporation—reported combined 1957 shipments of nearly 850,000 tons, compared with 500,000 tons in 1956. Mexico has now captured about 10 per cent of the U.S. Frasch sulphur market against less than 3 per cent in 1956 and is probably selling nearly one-fifth of the Frasch sulphur which is shipped abroad.

Compania de Azufre Vera Cruz, a subsidiary of Gulf Sulphur, was granted permission by the Government Mining Development Commission to assume control of a 7,000 acre concession formerly owned by Pan American Exploration of Mexico, which adjoins Gulf Sulphur's own 7,500 acre property on the Isthmus of Tehuantepec. The company estimates reserves on its own property at more than 13,000,000 l.tons.

Production by the Mexican Gulf Sulphur Co. and its affiliate, Azufrera Mexicana, was halted early in 1957 when the company's dome was exhausted, but the company is negotiating with the Government for new areas.

President Ruiz Cortines has approved a plan to establish a large metallurgical plant at Manzanillo on the Pacific coast, to absorb the iron ore output of the States of Colima, Michoacan and Jalisco. It is expected that this will lead to full exploitation of the reputedly immense ore reserves of Las Truchas in Michoacan, which have been surveyed by Krupps. The capital, estimated at 350,000,000 pesetas, will be provided by Nacional Financiera.

Mexico, which produced 360,000 tonnes of barytes in 1957, expects to produce 400,000 tonnes this year, mainly for export to the U.S.

Mercury production in Mexico, which rises and falls with world prices, is continuing at a rate which assures this country of third place among world producers. In 1956, the last year for which complete statistics are available, production totalled 19,531 flasks. The 1957 output was expected to be only slightly lower.

PANAMA

SEVERAL local and U.S. companies are interested in the mineral resources of Panama, the emphasis being on manganese and bauxite.

The Rosario Exploration Co. will exploit manganese deposits in the Rio Boqueron area of Colon Province, while two subsidiaries of American aluminium companies have acquired four-year mining rights for bauxite in the provinces of Colon, Veraguas and Chiriqui. Kaiser Aluminum and Chemical Corporation, which has obtained a bauxite exploration and mining concession, considers that Panama may become a major source of bauxite.

Owners of a mining concession on copper deposits near Tole reported that a U.S. firm was sending geologists to study the lode.

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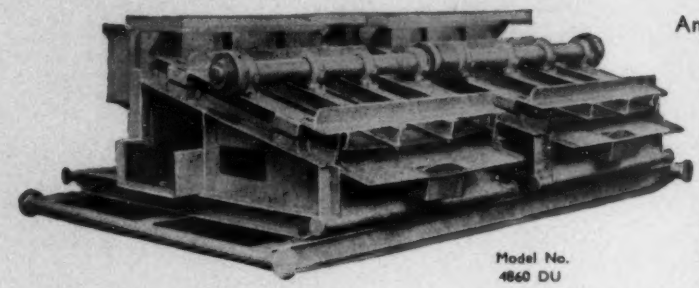

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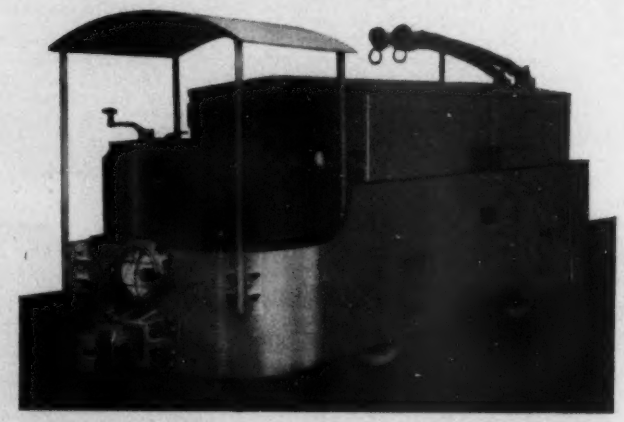

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THE CARIBBEAN COUNTRIES

THE Caribbean islands supply more than half the Free World output of bauxite, which during 1957 reached an estimated 18,300,000 l.tons. Oil is produced in Venezuela and Trinidad, the former country being the world's second largest producer and the largest single exporter, while Trinidad is also an important producer. Other minerals produced in the Caribbean include cobalt, nickel, iron ore, manganese ore, chromite, gold, diamonds, silver, salt, gypsum, copper, lead, asbestos, barytes, coal and magnesite.

Bauxite and Alumina

Jamaica produced 4,634,000 tons of bauxite in 1957, of which about three-quarters was probably exported to the U.S., the balance being converted into alumina on the island. Alumina Jamaica Ltd. exported 435,746 tons during 1957 compared with 207,333 tons in the previous year. The capacity of its Kirkvine alumina factory has been raised to 490,000 tons a year, while its new factory at Ewarton, scheduled for completion in 1959, will have an annual capacity of 190,000 tons. The two factories will be capable of treating nearly 2,000,000 tons of crude bauxite per year.

Reynolds now produces bauxite in Jamaica at an annual rate of 2,000,000 l.tons, while the Kaiser subsidiary is expanding its scale of operations to 4,000,000 tons a year. It is anticipated, therefore, that by 1959 Jamaica will be producing over 6,000,000 tons of bauxite and 680,000 tons of alumina a year. Last year Kaiser mined and shipped a total of 3,641,253 l. dry tons, exclusive of alumina.

Harvey Aluminium, of America, has leased over 600 sq. miles from the Jamaican Government under a two-year agreement and now has a team searching for bauxite. The licence is renewable for a further three years.

In 1957, Surinam, the second largest bauxite producer, had an output of 3,452,400 l.tons. It is expected to become the fourth largest supplier of aluminium metal in the western hemisphere as the result of an agreement between the Surinam authorities and Alcoa, who will jointly proceed with a $10,000,000 hydro-electric and development project. Alcoa will begin construction by 1960 of a dam, power-house and transmission line, as well as of a 60,000-ton aluminium smelter, near the bauxite mining centre of Parinam, and a bauxite refinery using local material. It is expected that the power project will take five years to complete.

An Alcoa subsidiary has conducted mining operations for bauxite in Surinam for 42 years under the name of Surinaamshe Bauxite Maatskappij. Henceforth, it will direct all Alcoa's activities in that country under the new name of Surinam Aluminium Co.

In March, 1957, the Reynolds Co. commenced the shipment of bauxite from their mines in Haiti, which are equipped to handle from 400,000 to 900,000 tons per year.

The Alcoa Exploration Co. holds a concession, granted in 1945, for the exploration of bauxite deposits in five provinces of the Dominican Republic. The company is expected to begin extraction shortly in the province of Barahona. It is likely that further prospecting for this mineral may be undertaken and that a processing plant will eventually be established.

Bauxite production in British Guiana fell to 2,106,800 l.tons in 1957 from 2,480,943 tons in the previous year. The Demarara Bauxite Co.—a subsidiary of the Aluminium Co. of Canada—has slowed down the rate of construction on its $60,000,000 alumina project at Mackenzie, 60 miles up the Demarara River. The scope of the project remains unchanged.

A Canadian expert has been surveying the bauxite potentialities of Venezuela under technical assistance arrangements made through the U.N.

Petroleum

The year 1957 was the 40th anniversary of Shell's refining activities in Venezuela. It saw Venezuelan production of petroleum rise to 145,000,000 tonnes from 129,100,000 in 1956. In the latter part of the year, however, the world surplus of crude and import cuts in the U.S. led to a sharp cutback in Venezuelan crude production. By December, 1957, it had fallen to 2,500,000 bbl. a day from an average of 2,900,000 in the first six months. It is estimated that in the first quarter of 1958 Venezuelan production was as much as 10,000,000 tonnes a year below capacity.

During 1957, both newcomers and established companies succeeded in opening up new sources of production, particularly in Lake Maracaibo. Much interest is also being taken in the drilling now taking place in the Gulf of Paria, the Trinidad section of which is already producing oil. However, the setback has affected all producers, its implications for the newcomers being particularly serious. Although discoveries in the last few months have justified high prices paid for concessions, the problem of output is extremely pressing.

Nevertheless, the long-term outlook remains very favourable. It has been forecast that net U.S. oil imports will have to be trebled to 3,000,000 bbl. a day by 1956 and Venezuela will supply much of this. Moreover, Venezuela supplies heavy crudes and fuel oil which are not produced in the U.S. in sufficient quantities.

Oil exploration is being undertaken in the Dominican Republic by a company formed with Dominican and American capital. Oil was struck at Higuerito in Azua, where further exploration continues.

Gold and Diamonds

Production of gold in British Guiana amounted to 16,490 oz. in 1957, being 675 oz. more than in 1956. British Guiana Consolidated Ltd. now has its new dredge in the Konawaruk River in operation.

British Guiana's diamond output fell in 1957 to 241,844 stones totalling 29,037 metric ct., being a decrease of 5,146 stones and 778 ct. from the previous year.

In a survey of the Colony's diamond resources by the British Guiana Geological Survey, the view is expressed that the days of the small parties of prospectors working in individual claims are numbered. The main potential of the diamond industry is considered to lie in the large-scale mechanized exploitation of the terrace deposits. There is a possibility that alluvial diamond mining might be revived in the Marlissa area, upper Berbice River, if intensive prospecting in carried out.

Diamond production in Venezuela for the first six months of 1957 amounted to 70,605 ct. as compared with 47,380 ct. during the same period of the previous year and 93,833 ct. in all 1956.

There is a small production of gold in Cuba, amounting in 1955 to 2,024 oz. By a decree issued on April 30, 1957, the Director of the Currency Stabilization Fund of the National Bank of Cuba ordered concessionaires of gold mines to start exploitation within six months.

Nickel, Cobalt and Chrome

The U.S. Government-owned plant in Nicaro, Cuba, produced a record total of 22,500 s.tons in 1957. The authority under which the General Services Administration hired the National Lead Co. to operate this plant expired at the end of 1957. Disposal of the plant to private enterprise has not yet been accomplished, however, among the reasons for bidding reluctance being the question of possible taxation. The U.S. Government pays no taxes on the plant and its products to the Cuban Government. In the absence of an acceptable bid, G.S.A's current operating agreement with National Lead was expected to be renewed for a further year.

Freeport Sulphur Co. has embarked on initial expansion of its nickel project in Cuba, for which it has arranged to borrow a total of $100,250,000. Production from the Moa Bay properties is expected to begin in mid-1959. Annual output of 25,000 s.tons of nickel metal and 2,000 s.tons of cobalt will

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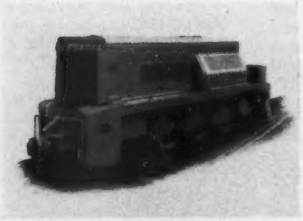

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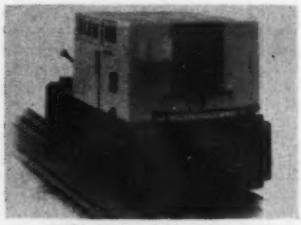

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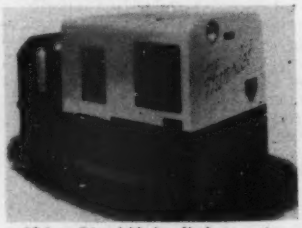

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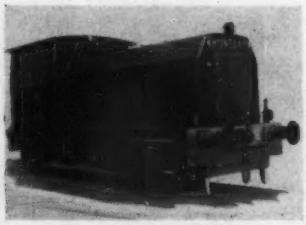

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make Cuba the second largest nickel source in the world and the largest cobalt source in the western hemisphere. A Freeport subsidiary in Cuba is reported to have proved reserves of 50,000,000 tons in one location, containing about 1.35 per cent nickel, which the company expects to begin mining in 1959.

There is expected to be rising production of nickel in Venezuela in the region bounded by Aragua and Miranda States.

Canadian interests are prospecting in the interior of the Dominican Republic for deposits of nickel ore, which is believed to exist in substantial quantities.

Production of Cuban refractory grade lump chrome ore in the Moa Bay district of Oriente Province declined from 80,000 s.tons in 1956 to 60,000 tons in 1957. However, as a result of development work and opening up of new deposits by Minera Moa, S.A. and Compania Cayo del Medio, S.A. an upturn in the rate of production of this high-grade chromite is now expected.

Iron and Manganese

The expansion of iron ore production in Venezuela continued in 1957, when output was estimated to have reached 15,000,000 tonnes. The Orinoco Mining Co., which is the largest producer, has set this figure as its own export target in 1958, when Venezuela expects to become the world's largest exporter of iron ore. A new company, Mineroferroviaria de Venezuela C.A. (Mivenca) was formed during 1957 with a capital of Bs.114,000,000 to exploit the El Trueno concessions of Transwestern de Venezuela. It is claimed that more than 150,000,000 tonnes of iron ore had been proved within the 14,826-acre concession. The development programme calls for construction of a 95-mile railroad and development of port loading facilities at Ciudad Bilivar. Estimated cost of the project is $52,000,000.

Iron ore is mined at Hatillo in the Dominican Republic, some 40 miles north of Ciudad Trujillo, and transported by road for shipment to the U.S. The content of iron is 67.42 per cent. In 1956, 164,000 tons of ore was extracted. It was expected that in 1957 production would be doubled, due to the installation of new machinery and the discovery of important ore deposits in several areas.

A new mining firm, International Metals Ltd., has acquired all shares of the Mavis Bank Mining Co., which held mining leases and exclusive prospecting permits over 7,000 acres in Jamaica. Preliminary surface stripping supports the firm's belief that deposits of high grade iron ore and copper ore exist in commercial quantities.

The North-West Guiana Mining Co. expects to go into commercial production of manganese ore in 1959 in the north-west district of British Guiana. The proposed capital investment is $20,000,000. Production is estimated at 10,000 tons per month during 1959, increasing to 30,000 tons per month during 1961. Government concessions in an agreement with the company include a five-year tax holiday and a licence to import, customs-free, capital equipment for a specified period.

Jeanette Minerals Ltd. of Toronto, Canada, is reported to have blocked out 200,000 tons of manganese ore averaging 25 per cent Mn on its property in Cuba. Mining and milling equipment for a 200-ton-per-day operation are currently being assembled.

Manganese mining operations of the Upata Mining Co. in Venezuela have ceased for the present. A reorganization is in prospect.

Other Minerals

The Dominican Republic possesses the largest salt deposit in the world in the province of Barahona. The construction of a $1,000,000 salt refinery—one of the largest in the American continent—was recently announced. It will satisfy home demands and provide salt for all the Caribbean countries.

Salt production in Venezuela during 1957 was estimated at 100,000 tonnes. Mechanization of the Araya salt deposits in the State of Sucre is well advanced.

Phosphate rock deposits in Falcon, Venezuela, are to be used to supply 50,000 tons a year for a fertilizer plant. Several exploitation concessions have been granted to private concerns.

Efforts are being made by the Ministry of Mines and Hydrocarbons in Venezuela to rehabilitate and recondition the Naricual coal mines, from which an output of some 1,500 tonnes per day is expected to become available in the near future. Production was scheduled to start towards the end of 1957.

A search for radioactive minerals began in British Guiana in November, 1957, when officials of the U.K. Atomic Energy Authority started investigations in the interior.

BOLIVIA

BOLIVIA had a disappointing year in 1957. The *Boliviano* continued its decline; foreign exchange earnings took a severe toss ending up around 30 per cent below the level of the previous year; the cost of living index did indeed show some quite sharp falls in the summer and early autumn but this was achieved in the face of considerable unrest and decline in output in some industries, so that its contribution to the ending of inflation was problematical. All in all it was not a good year and better fortunes must attend a revival in the prices of tin, lead and zinc and more favourable weather for the agricultural industry.

Yet Bolivia did make very considerable efforts during the year to get her economy on to an even keel and to shake off some of the inefficiencies in her system. The main weapon of the Government's attack on inflation was the Stabilization Programme, which was started in December, 1956. Under the programme industries were to be allowed to dismiss superfluous labour, which in the tin mines was said to amount to more than 6,000 miners. But in August, the Government weakly signed an agreement with the unions withdrawing this right and promising that the Government would make available grants for investment to those industries that could only develop with fresh capital. The Government's policy was not entirely overthrown, however, for the National Mineworkers' Federation Congress gave its support to the freeze of wages and fringe benefits and urged on the miners better discipline.

One of the works of the Stabilization Council was to uncover the true extent of Bolivian indebtedness. Thereafter, the Bolivian Government made a fresh effort to make arrangements for debt repayment so as to regain credit worthiness abroad. The total of Government indebtedness is now put at $160,000,000 exclusive of the debts outstanding on the expropriated tin mines. In March a commission was set up to consider compensation for the former tin mine owners. In the first half of the year Patino Mines and Enterprises Consolidated Inc. reported that it had received $541,366 in accordance with the agreement made in December, 1956.

During the year a vigorous attempt was made to try and bring some order into the working of the mining industry. A document was drawn up, signed by Corporacion Minera de Bolivia (controlling the nationalized mines), Banco Minero de Bolivia, Asociacion dos Mineros Medianos (medium mines) and Camara de Mineria (small mines).

The document demanded:

1. A reduction in taxes and limits to be imposed when metal quotations fell below specified prices.
2. Social Security payments to be reduced by 30 per cent.
3. Marginal mines to be helped to avoid closure.
4. Special contracts to be negotiated for a reduction in freight rates.
5. Credits at low rates for mine development.
6. Banco Minero de Bolivia to be reorganized with a greater degree of independence and more producer representation.
7. Exporters to find their own markets where possible.
8. A permanent committee of producers to advise the government.

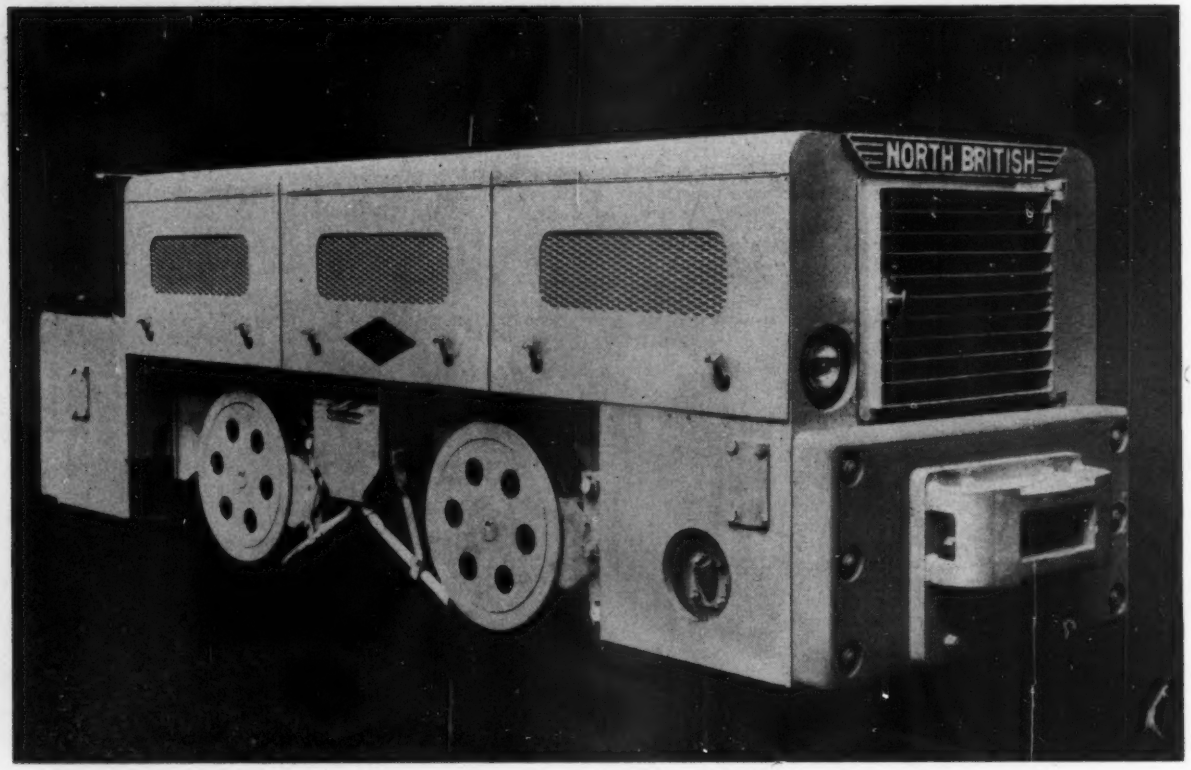
The conference also asked for the revision of the agreement with the American Smelting Co. on the Corocoro mine and an opening up of the Matilde mine.

On October 23 the Government reorganized the Banco Minero, but more in accordance with the recommendations of Ford, Bacon and Davis than with the document quoted above. The decree allowed five representatives of private mining interests on the board, but counterbalanced them with five nominated by government and a president also nominated by government. The new board was then charged with reorganizing the bank and was asked to sit permanently till this was done.

Meanwhile the Bolivian industry was having hard times. The fall in the price of tin made working even more uneconomic (at the best of times it is carried on as much to earn foreign exchange as to make a profit). Ultimately tin quotas were imposed and some Bolivian mines had to consider closing. Furthermore, the industry was threatened by higher tariffs on lead and zinc in the United States. The Ministry of Mines said that the proposed tariffs would throw out of work 10,000 employees and close down 750 mines. (A fairly wild guess this!). Finally the industry was hurt by the slowing down or cancelling of American stockpiling activity for certain metals. Thus the Bolsa Negra wolfram mine closed down and the Kami mine ceased mining wolfram and turned to the extraction of tin only.

On the other hand there were many promising developments, some of them arising directly out of the Bolivian attempt to turn over a new leaf and treat foreign capital reasonably.

A NEW UNDERGROUND MINES LOCOMOTIVE



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National Lead Co. confirmed that it had negotiated for two years on opening up Matilde mine. A draft agreement provided for a probationary period of from 6 to 12 months to study the miners operating conditions and a lease (which could be extended) of 25 years. Ventures Ltd. of Canada and Vitro Minerals Corporation set up a new company called Bolivex Corporation to explore untapped resources of Bolivia.

Germany is establishing a Technical Institute at La Paz University and this is thought in Germany to be a useful means of getting an entry to the mining industry. Germany is Bolivia's third best customer. There was more news of that old chestnut—a tin smelter for Bolivia—from several sources. Placer Development Ltd. was reported to be negotiating with the Government to set up a concentrator to treat the dumps of the Catavi mine. The American firm of Kornblum Metal and Associates were said to be planning a smelter. Also both the mining corporation and the mining bank made special studies of laboratory experiments in smelting low-grade tin at the Achachachicala laboratory. The process used was the Hormet method.

An agreement was reached between the Bolivian Government and the Bolivian Exploration and Development Co. to start placer gold operations along the Beni, Kaki, and Mapiri rivers; and the South American Gold and Platinum Co. has begun gold dredging operations in the same area.

As in the past three years it was the oil industry that made the most progress and oil exports continue to grow in importance. The date on which the country can be relieved of exporting tin at a loss to earn foreign exchange is not in sight, but oil is certainly making a vast difference to the economy.

BRAZIL *By Our Own Correspondent*

DURING the first nine months of 1957 the Department of Mineral Production (D.N.P.M.) issued 147 concessions to prospect mineral deposits. A mining licence is granted if prospecting shows the deposit to be of commercial value. Approximately one-third of prospecting concessions are eventually converted to mining licences.

Mineral occurrences discovered in 1957 include: one of cassiterite, with 72 per cent tin, in the Rondonia Territory and another at Baturite, Ceara; wolframite in Sta. Catarina; high-grade manganese at Muniz Freire, Espirito Santo; deposits of uranium minerals in Minas Gerais and Sao Paulo; one of zinc and one of platinum in Minas Gerais; mercury on River Urubu, in Amazonia; two of lead in Sao Paulo; chromite in Bahia and magnesite near Itapiuna, Ceara. A deposit of lead was confirmed in Sao Paulo and a licence was issued to mine rutile in Ceara.

Non-ferrous Metals

In 1957 D.N.P.M. researchers concentrated on areas believed to be rich in non-ferrous metals, such as the Ribeira do Iguape zone of Sao Paulo and Parana, the Diamantina Plateau in Bahia and Minas Gerais, and the Sao Sapé region of Rio Grande do Sul. Deposits of copper, zinc, lead, tin, chromite, nickel, cobalt and vanadium were prospected.

Occurrences of lead in the Ribeira Valley were systematically studied. Thirteen of Brazil's active lead mines are in this region, the most important being Furnas, Macacos, Morro do Chumbo, Espirito Santo and Juquatirica in Sao Paulo, Cerro Azul and Imbuial (Panellas) in Parana. Production increased from 4,498 tons in 1956 to 6,750 tons in 1957.

The Jacupiranga deposit of 3-4 per cent nickel, with reserves estimated at 250,000 tons, is being worked by Sao Paulo Mineraçao. All nickel ores discovered to date in Brazil, including those of Niquelandia, in Goias, with 20,000,000 tons of 2 per cent Ni., are silicated ores.

Research was speeded up last year in the Vazante district of Minas Gerais, where promising deposits of zinc, copper and lead minerals were located in 1955. The mining company has been reorganized and considerable development is expected. Occurrences of lead, zinc, silver and vanadium were proved north-east of Vazante in 1957, at Romas, Lontra, Serra de Cantinho and Itacarambi.

In Bahia Mineraçao Boqueira was authorized to exploit lead and associated metals at Macaubas. D.N.P.M. investigated deposits of lead at Bom Jesus da Lapa and copper at Caraiba. The Buqueira lead mines, extending over 2,000 metres in Central-south Bahia, are believed to be the most important occurrence in Brazil. At least three bands of 1-10 m. thickness exist at Morro do Cruzeiro, and two have been proved at Morro Pelado, one 200 m. long by 3 m. thick. Opencast mining started in 1955 and output averages 1,000 tons of oxidized mineral, with 50 per cent lead; production reached 2,650 tons in 1957. Plants now being installed at Sto. Amaro, Bahia, and Nova Iguacu, Rio de Janeiro, should raise Brazilian production to 20,000 tons annually in 1959.

Companhia Mineraçao Sul-Brasileira started working the new galena mine at Blumenau, Sta. Catarina, and processing the ore. Reserves are estimated at 1,000,000 tons.

In Rio Grande do Sul prospecting for copper and tin was extended to Primavera, Crespos and Cerro dos Martins. Professor Otto Barth, of Stockholm, was engaged to inspect the Serval and Camaqua mines (Cacapava), where it is proposed to extract copper. Brazil's known reserves of copper minerals suffice to produce 523,000 tons of fine metal, but production did not exceed 8,000 tons last year; i.e. 32 per cent of consumption.

Radioactive Minerals

D.N.P.M. prospected deposits in Minas Gerais, Rio de Janeiro and Espirito Santo in 1957. New areas, rich in monazite sands, were identified in Maranham and Piaui. In Minas Gerais an occurrence of autunite of hydrothermal formation was located in the Serra da Moeda and, in Sao Paulo, another deposit of uranium mineral was found at Agua da Prata. The first chemical tests gave 0.24-0.68 per cent U308. Uraninite was identified in Pre-Cambrian gold-bearing conglomerates in the Jacobina range, Bahia.

Research was continued in the highly-mineralized pegmatite zones of north-east Brazil and in the deposits of zirconium and uranium minerals in Minas Gerais. In Sao Joao del Rei D.N.P.M. measured reserves of alluvial, elluvial and primary deposits of tin-uraniferous ores and installed plant at Nazareno to process the mineral. U.S. researchers are participating in Brazil's search for uranium minerals and a French consortium will install two processing plants. Brazil's first research reactor has been set up at Sao Paulo university. The plant is of the "swimming pool" type, with a potential of 10,000,000 watts.

Coal

The National Coal Plan, prorogued until 1960, allots 2,000 million cruzeiros (£10m.) to raise annual production from 2,000,000 to 3,000,000 tons and improve quality. In Parana D.N.P.M. completed the examination of a new seam, extending for 60 miles from Abaiti to Ortigueira; measured the Tibagi and Peixe reserves, amounting to 42,000,000 tons, and continued prospecting the newly-located deposits of Sao Sape, Rio Grande do Sul. Research in the Tocantins-Araguaia Basin, a new area, revealed the existence of an important seam of American type coal at Carolina, in Maranham.

Iron and Manganese

In 1957 D.N.P.M. started measuring Bahia's reserves of iron ore, which rank second to those of Minas Gerais, and continued the search for new deposits. The most important occurrences are those of the Middle Sao Francisco and Rio das Contas. Concentrations of hematite have been located at Brejoes; magnetite with 66.81 per cent Fe at Jequirica and 50-60 per cent at Pedras do Ernesto and Tapera; also, itabirite and hematite, with high iron content, in Serra das Eguas.

In Espirito Santo the recently-discovered deposits of iron and manganese at Guacui and surroundings were examined and, in Minas Gerais, U.S. and Brazilian geologists continued measuring the reserves of the Iron Ore Quadrilateral and Serra da Canastra.

In February 1958 the M. A. Hanna Company of Cleveland announced that it had taken control of the St. John d'el Rey Mining Company, whose mineral holdings include a tract of land between Itabria and Congonhas containing what it thought to be the largest single holding of high-grade ore reserves in Brazil. A large-scale investigation into transport and marketing problems is now under way. Economic conditions permitting, production will start in three years.

Brazil's exports of iron ore increased by 755,000 tons between 1956-57 to 3,500,000. The government's programme aims at exports of 8,000,000 tons in 1960.

ICOMI, associated with Bethlehem Steel, started exporting manganese last year from the Amapa deposits, discovered in 1946, and raised shipments to 700,000 tons, from 260,000 in 1956; 75 per cent of the shipments went to Bethlehem Steel's American plants.

Petroleum

Production of crude petroleum increased from 4,065,000 barrels in 1956 to 10,106,270 in 1957; natural gas, from 83,877,536 to 158,480,700 cubic metres; new wells completed, from 47 to 89; refining capacity, from 118,000 b/d to 131,000.

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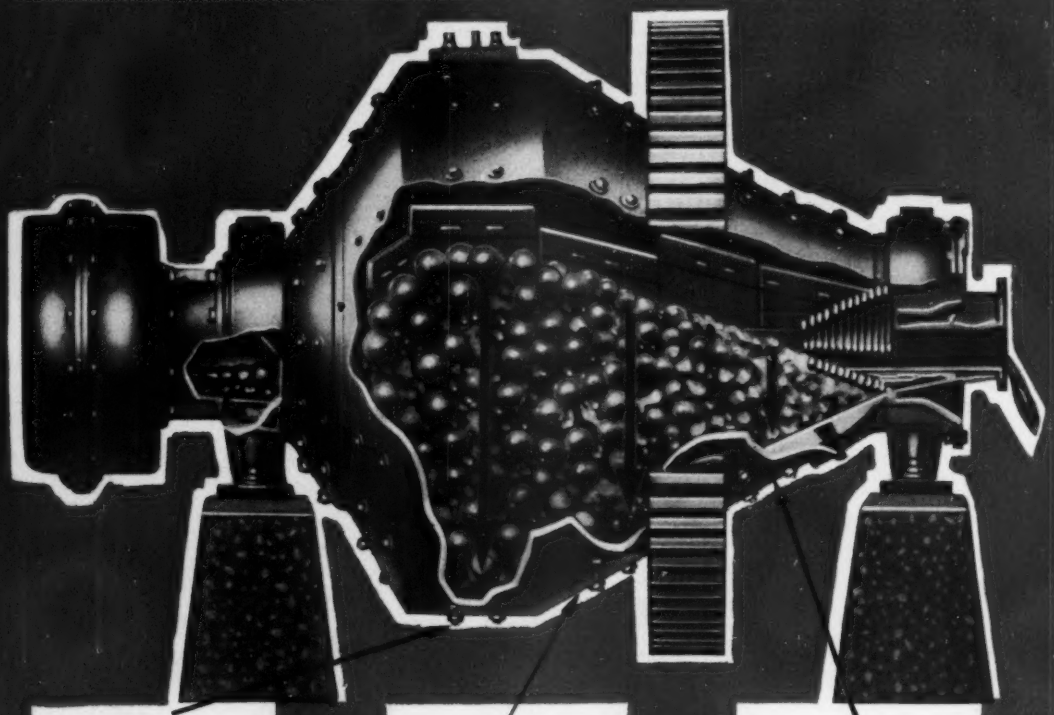

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CHILE

THE year 1957 was for Chile the year of reckoning. The price of copper stayed disastrously low throughout the 12 months, and the efforts to get the economy on to an even keel were hampered by drastic falls in exchange earnings and internal revenue. The Chilean Central Bank has estimated that for every 1 c. per lb. decline in the copper price, the decrease in revenue from copper tax amounts to $6,300,000, apart from the effect on the balance of payments. As if that were not enough the nitrate industry ran deeper into difficulties and Klein and Saks have now been retained to advise on this problem, too.

Copper

Apart from the national consequences of the fall in the copper price, the Government had to consider what the reaction of the copper industry should be. According to the Copper Law the companies could cut output by not more than the proportionate cut made in their American properties. Negotiations went on from the Spring onward and rumours of their outcome played on the world markets; a figure of 10 per cent being the most commonly forecast cut. But in June the Copper Department said there would be no cut; instead, production for 1957 would be pushed up to 500,000 tons so as to offset the fall in price. The announcement further weakened the market. When El Teniente had to cut output in the early summer the Copper Department hastened to point out that this was because of a water shortage.

Considering that right up to the end of the year, Chile persisted in refusing to allow production cuts, the American operators did well to keep output to 475,000 l.tons, compared with a planned output of 505,000 tons and with the 1956 production of 482,000 tons.

Allocations of electrolytic copper for the domestic industry have been increased to 27,000 tonnes from the initial figure of 15,000 tonnes allotted for 1958, the reason given for this step being an increase in export orders for 5.8 mm. copper wire. The total amount of copper allocated for the home industry is 40,000 tonnes, the balance being made up of blister copper.

The opportunities for exporting copper-manufactured products were first glimpsed in 1957, when the Government decided to authorize the shipment of copper wire up to 6 mm. gauge to all countries, including the Soviet bloc and Communist China. At that time the step was considered to be of a political nature, intended to appease local agitation for "trade with all the world," meaning the Communist countries. The response was prompt, however, though the fruits have been slow to ripen. A Chinese trade mission was sent to Santiago for exploratory talks, but no agreement was reached. Talks were also started in Europe with the U.S.S.R., but looked like proving abortive because the U.S.S.R. wished to conclude a barter deal, while Chile was not interested in the products offered in exchange, partly because of its need for dollars. Finally, a triangular deal bringing in West Germany was worked out. Under this deal Chile will sell 20,000 tons of copper wire to the U.S.S.R. in monthly deliveries of 2,000 tons. The payment will be in dollars, by West German firms, which in turn will get Soviet products.

A further problem caused by the fall in copper prices was that of the small producers whose output was bought by Caja de Credito y Fomento Minero. As the price fell the Caja got further into difficulties. In March it suspended indefinitely the export of ores and concentrates and decided to have them refined at Paipote, the national refinery, which would produce a better return. In November a report from Sociedad Nacional de Mineria to the Government demanded that the small and medium mines should have the same Customs privileges as the nitrate industry in respect of imported machinery and equipment, better tax allowances and a special electric power tariff. In fact the Government merely countered with a promise to continue to buy at 29.50 c. per lb., raising the funds with a higher tax on exchange operations. If the tax produced a surplus it was to be used to provide mining equipment and plant. The Caja was also given a cheap loan for development work.

Papudo, 80 km. north of Valparaiso, has been selected as the site of Chile's new copper refinery. Machinery now arriving is for an initial capacity of 150,000 tons of blister yearly plus an electrolytic refinery for 42,000 tons. This capacity is expected to be expanded so that eventually 450,000 tons of blister copper will be produced plus 63,000 tons of electrolytic. Blister copper produced at the Paipote smelter will be sent south to Papudo to be turned into electrolytic. Up to the present, the small and medium-sized copper producers in Chile have been sending their products for refining in Hamburg, but recent increases in freight rates have made this operation uneconomic.

An outstanding event was the formal opening of La Africana mine by the late Mr. Roy Glover, president of Anaconda, on October 25. It is said to be among the most modern in the world and will treat 500 tons a day of 4 per cent ore. Anaconda's Chilean output is to be increased from 27,000 s.tons to 33,000 s.tons monthly by 1959.

Braden Copper Co. was empowered early in the year to invest $3,100,000 in Chile; $1,700,000 for a new sulphuric acid plant and $1,400,000 for four condensing tanks. Braden, at the close of the year was allowed to invest a further $2,800,000 to extend the flotation section of the El Teniente mine.

Three private investment organizations—the American Overseas Finance Co.; the Bank of America (International), New York; and J. Henry Schroder Banking Corporation—and the International Finance Corporation signed agreements providing for loans amounting to $6,400,000 as part of a financial programme totalling $12,800,000 to develop a copper mine and smelter owned by Empresa Minera de Mantos Blancos SA, a Chilean corporation. The properties are located 45 miles northeast of Antofagasta. Empresas Sudamericanas Consolidadas SA and Marvis Corporation SA, owned by the Hochschild Group, are supplying equity of nearly $6,400,000 to Mantos Blancos. For several years, work has been under way, defining the orebodies and through pilot plant operations, developing a satisfactory metallurgical process. Construction of the mill and refinery have started. When in operation, the mill will process 2,000 tons of ore daily, producing about 12,500 s.tons of refined copper per year.

United Satamin Mining Ltd. of Canada was allowed to invest $2,900,000 to develop the Sagasca mine.

A large copper orebody has been discovered near Cabildo in the Province of Aconagua.

In labour affairs the year was moderately quiet. A strike at Chuquicamata ended in a wage award of 1,600,000,000 pesos backdated to January 1, 1957, to run for 15 months. At the time of writing workers at Chuquicamata are again on strike.

A second strike at El Teniente was settled with an agreement backdated to April 1 (and also lasting 15 months); it cost 13 days' production and the wage increase was more than double what was permitted by law. Thus inflation grows!

Nitrate

The year 1957 was a bleak one for the nitrate producers. Less than a year after the passing of the Nitrate Referendum, which was to put the industry on its feet, several producers on the Pampa de Iquique were asking permission to close down. What the producers gained from the referendum they more than lost on currency reform. Although the industry was allowed to use the free rate of exchange, the peso did not fall as much as the price of nitrates; further, as bilateral trading was frowned on by Klein Saks the industry lost customers who had hitherto been tied to them by this system. Klein Saks had in fact been asked to report on the industry and frightening rumours about the report were circulating when the president of Anglo-Lautaro visited Chile. He said that the referendum had just saved the industry—if the necessary capital could be found. He pointed out that whereas the Shanks process required 15 per cent nitrate, and the Guggenheim (which is what the big producers now use) 7 per cent, the solar evaporation system used 5 per cent. This increased the reserves by nine times and would also permit a chemical industry to grow on the by-products.

When the Klein Saks report came out it declared that the industry had a bright future if it had an injection of capital and kept itself technically abreast.

Coal

This has been a difficult year for the mines because of a surfeit of small coals which could not be easily disposed of. In the early part of the year the Lota and Schwager mines were both on short time and the low wages made a strike there an embittered one. The settlement was for less than half what the copper miners got.

Short time was also being worked at Coronel and Lota and both these and Schwager had difficulty in paying wages because of the unpaid debts, particularly of the railways.

After midsummer the situation improved. The World Bank made loans of $21,800,000 to Lota and Schwager in July and at the same time the companies signed a contract for 15,000 tons of coal a month to the Argentine railways.

Other Minerals

Cerro de Pasco has surveyed the Coihaique area of Aysen for lead and zinc.

Metallurgists under Point IV programmes have been studying manganese concentrates obtained from low-grade ores.

In October, Steel Co. of the Pacific took over the El Agarrobo iron ore deposit; the former owner, W. Muller and Co., together with American Overseas Finance Co., are to provide the foreign exchange necessary for development.

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PERU

WHEN the end of 1957 came Peru was in dire straits. This was not what had been expected from the performance of the first quarter of the year. Both exports and imports were at a record level and the continued high level of foreign investment—which alone covered the national deficit in 1956—promised well. But the seeds of trouble were there. A prolonged drought in the early months not merely ruined fruit and vegetable crops but involved the country in expensive imports of American produce. Later when the prices of Peru's main exports were falling seriously, the country passed into severe difficulties. Inflation took a further leap upward and the reserves which stood at $U.S.41,680,000 at the opening of the year were down to $U.S.10,060,000 at the close. Before the end of January the reserves were down to a mere 5,000,000 sols and the Central Reserve Bank had to abandon its policy of supporting the sol at 19 to the U.S. dollar.

But apart from the distressing decline in exchange earnings the country had to face a war of nerves that went on through most of the year. This was the result of the various attempts in the United States to raise the domestic tariff against imported lead and zinc. For most of the summer there was the threat that Congress would approve a proposed law that would have raised tariffs. When Congress adjourned in late August without approving the bill, attention turned to the Tariffs Committee which had to consider a tariff application from the Emergency Lead and Zinc Committee for a 50 per cent increase on both lead and zinc imports and for a system of import quotas on both metals. Arguments of this kind went on for most of the year and added to the general uncertainty. In the hearing before the Tariff Committee the case of the Peruvian industry was put by Robert Koenig of Cerro de Pasco, who pointed out what a disaster it would be for the Peruvian economy if any action were taken which would lower Peruvian exports to the United States.

MINERAL EXPORTS

	1956	1957
Gold..... f.oz.	103,000	**74,000**
Silver..... f.oz.	21,254,000	**21,994,000**
Lead ..... tonnes	121,000	**120,000**
Zinc ..... tonnes	144,000	**150,000**
Copper .... tonnes	44,000	**49,000**
Iron ore .. tonnes	1,630,000	**2,179,000**

Meanwhile the development of the industry went on. In November the anniversary of the starting of the Toquepala scheme was commemorated. The scheme had begun in 1956 with one of the biggest blasts in mining history when 1,067,000 tons of waste were blown after 700 churn and rotary holes had been drilled to a depth of 51,589 ft. and loaded with 270,000 lb. of explosive.

Copper

Lead and zinc mines in southern and central Peru had to close during the course of the summer because of the falling away of exports; fortunately, Toquepala was able to offer jobs to the unemployed miners. Because of the high cost of living a strike broke out at Toquepala during November and the Government was forced to suspend civil rights there and at Ilo.

At the end of 1957, Cerro da Pasco announced that it was cutting output at its Peruvian mines by about 11 per cent.

Lead and Zinc

The Peruvian Minister of Development and Public Works, visited Washington to register the Government's views on proposed tariff increases, which, it was alleged, would cost the country $U.S.20,000,000 a year. To help meet the problem of low prices, Peru dropped the transport charges on lead and zinc moving to the coast and negotiations were begun to try to secure a drop in ocean freight rates. In August it was announced that these negotiations were successful and freight rates on zinc were lowered by $1.50 a ton (other rates were unchanged). At the same time it was announced that export taxes would be abolished for lead and zinc so long as lead was below 15 c. and zinc below 12 c. per lb.

Iron Ore

The iron mines ran into difficulties too in 1957 because of the low level of activity in the American steel industry. This was particularly unfortunate in view of the rapid strides made by Peru in the past few years as an exporter of iron ore. There was some compensation in the fact that Japan looks like becoming a significant buyer.

In December, it was stated that the iron mines in Acarin near Arequipa would soon be in operation.

The Export-Import Bank has granted a $10,000,000 loan to a U.S. firm, the Marcona Mining Co., to assist in financing a $25,500,000 construction and expansion scheme at its mines in Ica.

Coal

In the spring an agreement was made in Paris for the sale of 1,500,000 tons of anthracite for delivery to France at a rate of 300,000 tons a year. The anthracite, which is to be got from mines in the Santa Valley, will be worth $33,000,000, of which $5,000,000 would be paid for in the shape of mine and transport equipment. In December Sofremines sent a team of engineers under contract to Santa Corporation to see if the mines could raise their output to 1,500,000 tons a year, and also whether the coal mined could be better utilized.

Aluminium

The new Paucartambo hydro-electric plant of Cerro de Pasco was formally inaugurated in March. This will serve many parts of the Corporation's complex since it will have an ultimate capacity of 100,000 kW. At the inauguration it was officially stated that the Corporation had obtained a licence to study another power project on the Mantaro with a potential of 1,000,000 kW. It was apparently linked with a scheme for producing refined aluminium in Paracas Bay; this would involve transporting the power over 180 miles. Later it was announced that Cerro de Pasco had reserved a site in Paracas for the refinery.

A new company was formed in June to develop lead, zinc, copper and silver near the source of the Chancay. Proved reserves total 4,000,000 tons of ore together with a possible 3,000,000. The ore is 12 per cent zinc, 2.5 per cent lead, 1.5 per cent copper and 3 oz. per ton silver. Capital required for mine and power plant would be $1,500,000.

COLOMBIA

THE chief mineral products of Colombia are platinum, gold and silver, coal, oil and emeralds.

Platinum is being dredged from several rivers in the province of Chocó by a Canadian company, the Chocó Pacifico Ltd. In 1956 production amounted to 26,215 oz.

Gold production fell in 1957 to 330,000 f.oz. from the previous year's total of 438,000 oz. Gold is dredged by Pato Consolidated Gold Dredging Ltd., in the provinces of Antioquia and Cauca and also in Chocó. The more important deposits have been worked for more than a century. Other producers include the Frontino Gold Mining Co. Ltd. in Antioquia and local companies in Caldas. During the six-month period ended June 30, 1957, Pato dredged 12,395,000 cu. yd. to recover 49,814 oz. of fine gold, compared with 13,407,000 cu. yd. for a recovery of 110,910 oz. in the corresponding period of 1956.

A special statute has been drafted for the precious metal industry. All gold, silver and platinum will, in future, be sold to the Banco de la Republica, which will become the sole exporter.

The emeralds of Muzú and Chivor are well known, those of the former being of a beautiful dark-green colour and unusual brilliance. Both deposits are situated in the province of Boyacá. Occurrences of the crude emeraldine mineral morraille are known in Cundinmarcá.

Coal of good quality is abundant, but has not been extensively exploited due to lack of modern mining equipment. Several foreign firms are interested in exploiting the large coal deposits of El Cerrejon in north-eastern Colombia. According to studies made by the Institute de Fomento Industrial, there are proved reserves of 212,000,000 tonnes of coal. There is also considerable interest in the coal resources of the Cauca Valley.

Iron ore occurs throughout the country and is exploited by the Siderurgica Paz del Rio de Province Boyacá. Considerable quantities of gypsum and anhydrite are mined for use in the manufacture of cement.

The St. Joseph Lead Co. has set up a Colombian subsidiary for the operation of a concession granted in Cundinamarcá. The intention is to refine lead locally.

The Richmond Petroleum Co. has a licence to explore and exploit nickel deposits in the Department of Cordoba.

The Compania de Uranio (Coluranio) hopes to be able to start commercial production of uranium before the middle of 1958 from its mines at California, Santander.

An extensive deposit of mercury is being exploited on a small scale. Three more deposits are known to exist.

The Government of Colombia regards the more intensive exploitation of mineral resources as an essential step towards the attainment of a more balanced economy. During 1957 special privileges were granted to the mining industry by decree. Henceforth all base minerals may be exported free of export taxes.

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AUSTRALIA *By Our Own Correspondent*

THE steady fall in the prices for metals has had a disturbing effect upon producers of base metals, tungsten minerals and beach sand minerals; so much so, that lead-zinc and copper mines must rely largely, if not entirely, upon investments to meet dividend payments. In the lead-zinc mines attention has been directed to economies, assisted by the automatic fall in lead bonus payments. There has been a steady increase in efficiency in all mines, both metal and coal, and throughout the year it was apparent that more ore was being won with less labour. Mechanization has been expanded steadily. To meet the economic position, mine outputs have been increased with a view to cost reduction, but at the expense of further loading a congested market. Exploration for new deposits by big companies, in new country as well as their own mines, has been continued actively.

The beach sand industry has been badly hit by the heavy fall in the market for rutile and zircon, and companies are being forced to suspend production, but production of ilmenite in Western Australia is being continued. Interest in uranium prospecting has waned and also in oil search, but strong companies in both fields continue active operations. In the north, Consolidated Zinc's subsidiary, Commonwealth Aluminium Corporation Ltd., is vigorously developing the great bauxite occurrence.

Gold

The industry has continued to face the fixed, and inadequate price for gold, but nevertheless, companies have continued development at the normal rate. Exploratory work beyond operating mines has been continued by Western Mining Corporation, with a new venture in the north-west of Western Australia, and on the Tennant Creek field in the Northern Territory. As for several years past, production has been by the old mines which are steadily attaining greater depths.

Increased assistance to the industry has been given by the Commonwealth Government under the Gold Mining Industry Assistance Act by an increase in the gold subsidy to a maximum of £2 15s. 0d. per oz., aid to small producers being raised to £2 per oz. Amount of subsidy paid to the industry in the year under review was £A495,496. The Gold Producers Association has continued to give useful assistance, premium sales during the year averaging 9.83d. above the standard price per f.oz. Since its establishment in 1951, the Association has distributed to producers the sum of £A1,870,969.

The Western Australian mines have maintained or improved ore reserves in the face of increased ore extraction; mechanization has been increased and greater efficiencies have resulted. On the Kalgoorlie and Norseman fields underground development generally has shown some increase in the grade of ore, notably at depth, and there has been no decrease in the percentage of development in payable ore to the total footage completed. Some pyritic concentrate is being railed to Freemantle to be roasted there for the purpose of sulphuric acid manufacture and the contained gold is there recovered in a special cyanide plant.

Western Australia has, of course, contributed the larger part of the Commonwealth gold output. Prominent on the dividend side is Hill 50 Gold Mine, at Mount Magnet, with £A3,900,000 in less than six years, and in the Northern Territory, Australian Development mine, with £A2,943,750 in about the same time. While the year's record by the gold mines is most satisfactory, there is, unfortunately, no newcomer amongst the producers.

Copper

Although production of copper was rather higher than in 1956, the hopeful outlook for the industry at the beginning of the year was dissipated by the steady fall in the copper market. Both Mount Lyell, in Tasmania, and Mount Morgan, in Queensland, the latter being essentially a gold mine, were able to increase output, but despite large-scale production, mining has not been profitable. The Australian price for the metal is steady at £A330 per ton. The Tariff Board has conducted an enquiry into the state of the industry and how help may be given in the emergency, but the report has yet to be issued. Mount Morgan's difficulties have been accentuated by the pyrite position and it is hoped that help will come from amendment of the Sulphur Bounty Act, designed to encourage the substitution of indigenous sulphide minerals for imported brimstone for the manufacture of sulphuric acid.

At Mount Lyell in the last half of the year, output was increased 59 per cent, resulting from new open cut arrangement and increased mill capacity. In the last quarter of 1957, 486,732 tons of ore were milled. A geophysical anomaly was tested by diamond drilling and a new ore body was discovered; considerable work has yet to be done before the bearing of the discovery on ore reserves can be assessed.

Mount Isa Mines Ltd. is pressing on with the £A3,500,000 electrolytic copper refinery at Townsville, Queensland. Its completion will permit an output of 7,000 tons of copper ore per day. Reserves now stand at 12,800,000 tons assaying 3.75 per cent copper.

In the Northern Territory, Peko Mines, at Tennant Creek, is a new producer with about 1,000,000 tons of ore developed, but is handicapped by the need to transport concentrate some 2,000 miles by road, rail and sea to the smelter, and high costs are inevitable. Smelting on the mine in that remote locality presents many problems. In Western Australia, Ravensthorpe Copper Mines is now producing concentrate, which is to be smelted at Port Kembla, New South Wales.

With the difficulties facing all producers it would seem that the survival of the industry under present conditions rests on a guaranteed price of £A370 per ton of copper. Mount Lyell and Mount Morgan should receive assistance from pyrite sales, and are open cut mines; their grade of ore is 0.66 per cent and 0.82 per cent copper respectively. Mount Isa and Peko are underground mines with average grades of 3.75 per cent and 8.50 per cent copper respectively.

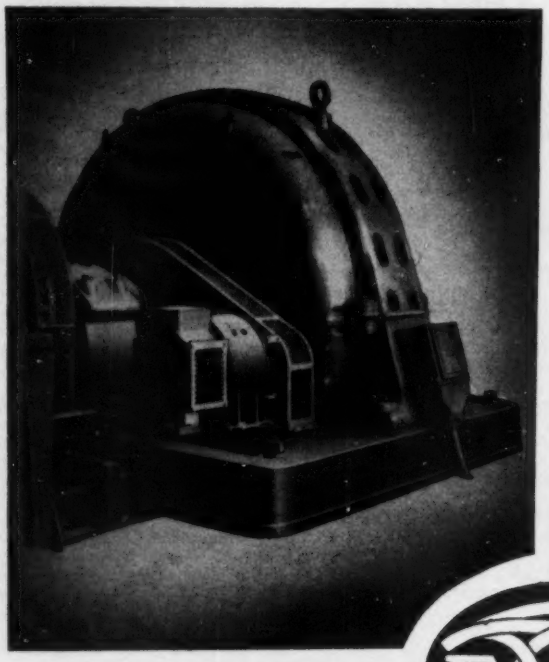
It is generally felt that Government assistance for the industry by means of a price of £A370 per ton of metal is essential for the protection of the copper industry.

Silver-Lead-Zinc

The year in Broken Hill has seen increased production from the mines at the south end of the lode, output by the North Broken Hill remaining steady in the last half of the year. Deep level developments have been good, but work north of the DeBavay fault has, so far, failed to locate anything of importance. New shafts and construction are well advanced. New Broken Hill Consolidated and Zinc Corporation stepped up ore extraction and lead and zinc concentration production considerably; higher grade lead ore was mined. Broken Hill South also increased output of ore and concentrates, but there was a slight reduction in the grade of ore milled. This mine maintains ore reserves well, although lesser tonnages are being mined in the Barrier Central leases, working remnants left by the previous operating companies. Development in New Broken Hill and Zinc Corporation has continued very satisfactorily at depth, and Broken Hill South is carrying out interesting exploratory work west of the main ore channel in a large low grade formation. All companies are feeling the fall in metal prices, and New Broken Hill and Zinc Corporation have both decided to stockpile zinc concentrates.

Mount Isa Mines Ltd., Queensland, has increased reserves of silver-lead-zinc ore to 20,700,000 tons. A 4,500 h.p. winder has been placed at No. 2 ore shaft and nearly £A5,000,000 has, so far, been spent on the expansion programme. Higher grade ore has been mined to meet the market position and output has been raised. A novel procedure was the payment of a tax-free dividend in the form of fully paid shares. At the Northern leases, shaft sinking reached a depth of 514 ft. in this large ore body. Substantial sums are to be borrowed to complete the expansion programme which is currently in hand.

ROTATING MACHINES



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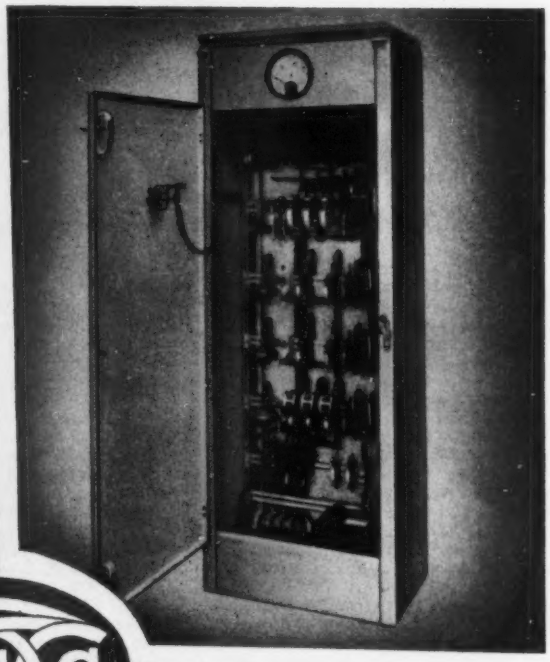

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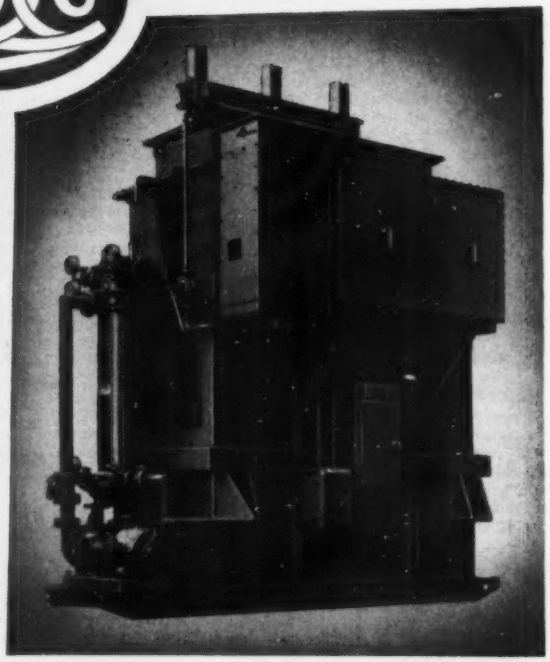

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The fall in metal prices has made a difference of £650,000 in profit to Lake George Mines, New South Wales. The lode is narrowing at depth and the company has asked for closer co-operation by employees if the mine is to continue.

In Tasmania, Electrolytic Zinc Co.'s West Coast mines have maintained slightly greater production and development has been good, with maintenance of ore reserves. Zeehan Mines Pty. Ltd., an offshoot of Broken Hill South, came on the dividend list.

Electrolytic Zinc Co. of Australasia increased production of metallic zinc at the Risdon works, but the immediate future is clouded by the metal market. Superphosphate and sulphate of ammonia are important by-products.

Tin

Facing a greater domestic demand for tin caused by the new tin plate works in New South Wales, tin production fell in 1957, although increase was hoped for. Production by the Tableland Tin Dredging Co., in Queensland, was below expectations, and the newcomer, Ravenshoe Tin Dredging, in the same State, has not yet reached full plant capacity. In Tasmania, normal output was maintained by Aberfoyle Tin and Renison Associated Tin Mines. Some contribution was made by the Storey's Creek tin and wolfram mine. Some prospecting for alluvial areas is reported in the north-east of Tasmania. Tin producers are urging some Government assistance to tin prospecting, both financially and by way of taxation remissions.

Three companies, United Uranium, King Island Scheelite, and Loloma (Fiji) Gold Mines, are jointly exploring for tin in the Northern Territory. A large area of the Maranboy tinfield is held and exploratory work to a present depth of about 200 ft. is stated to be disclosing a very promising lode. A new producer is very desirable, for last year's domestic consumption was 3,500 tons of metal, with production at 1,800 tons.

Aluminium

Production of metal at the Bell Bay, Tasmania, works reached 10,600 tons, extracted from imported Malayan ore. It is probable that this will be replaced by ore from Cape York Peninsula when the mining and shipping stage has been reached. An agreement has been drawn up between the Queensland Government and Commonwealth Aluminium Corporation Pty. Ltd. covering the working of the great Cape York deposit. Ultimate expenditure is visualized at £A200,000,000, covering exploration, town, harbour, alumina extraction plant, smelter, and provision of power. Aluminium Laboratories Ltd., of Canada, are also exploring in the vicinity, and Rio Tinto (Australasia) Ltd. have a permit to prospect in the Northern Territory where an occurrence of some 100,000,000 tons of bauxite is reported to exist.

Uranium

Figures released by the Government give the output of uranium oxide at the Rum Jungle, Northern Territory, plant as 541,652 lb. Production by Radium Hill, South Australia, is not known. The Rum Jungle plant continues to treat other Territory ores, but some high grade pitchblende has been exported. United Uranium Ltd. is to build a treatment plant at the South Alligator River. Other operators are suspending work.

The large Mary Kathleen plant in North Queensland is expected to come into production at the end of 1958, and the new technique of rain making is being employed to aid precipitation on the catchment of the 3,000,000,000 gal. capacity dam.

A new discovery of uranium ore was reported near Mount Isa, but otherwise, there is little prospecting for uranium minerals. The South Australian Government is concentrating uranium ore at the Radium Hill Mine, and carrying out chemical treatment of the concentrate at Port Pirie. Late in the year discovery of an ore body in the Flinders Ranges, South Australia, was reported.

Rutile, Zircon, Ilmenite

During the year there has been a substantial increase in the tonnage of rutile and zircon concentrates shipped from the east coast. The steady fall in price for the minerals to about one-third of last year's price for rutile has caused the closing down of a number of companies and the halting of other projects. Exports are largely under existing contracts at good prices; new producers without contracts are finding it difficult or impossible to make sales at prices which are economic. Low grade areas, taken up and equipped when markets were between £80 and £100 per ton of rutile concentrate, cannot now be worked except at heavy loss.

In Western Australia, ilmenite concentrate is being produced at a margin of profit, and shipped to European and Japanese buyers. East Coast ilmenite continues to be unsaleable because of the chromium content, the Western Australian mineral being chrome-free.

Tungsten

Tungsten mining was depressed during the year and small Tasmanian, Northern Territory, and Queensland wolfram producers closed down. King Island Scheelite production approximated that of last year, but Aberfoyle Tin output was reduced by the lower wolfram content of the ore. This company's and the Storey's Creek Co.'s contracts expired during the year; early in 1958, the overseas contracts of King Island Scheelite will terminate, and the company must sell on the open market. While Aberfoyle's reserves are decreasing, King Island Scheelite continues to maintain reserves at about 2,000,000 tons of open cut ore.

Iron and Steel

Steel production for the year approximated 3,000,000 tons and demand is unsatisfied. The Broken Hill Proprietary Co. operates at Iron Monarch, in South Australia, and is opening up and equipping the Iron Baron Mine in that vicinity. Supplies from this source are supplemented from the mine at Cockatoo Island, Yampi Sound, Western Australia. This ore is friable, and a plant for sintering has been erected at Port Kembla. The company is also testing deposits in the Cape York Peninsula and on the North Queensland-Northern Territory border. The B.H.P. Co. is carrying out research into the utilization of taconite, of which very large tonnages exist in the company's leases in the Middleback Ranges, South Australia.

The South Australian and Tasmanian Governments are planning State steel enterprises, if adequate reserves of iron ore can be proved. The former Government has already done considerable drilling, but it is thought that the results are far short of the desired objective. In Tasmania, anomalies located in the Savage River country are being drilled and results are said to be the best so far obtained in the State, though the quality of the ore is undetermined.

Coal

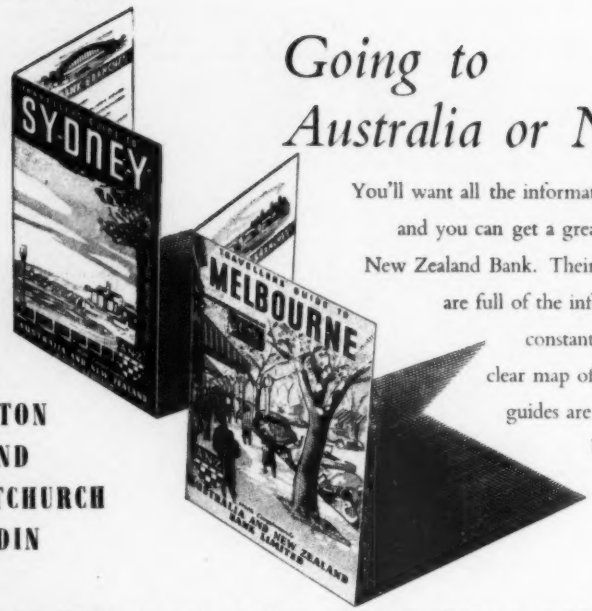
Although black coal has lost heavily to alternative fuels, and the position has caused such uneasiness amongst the coal miners' union as to produce a great decrease in industrial unrest on the coalfields and the withdrawal of the long-standing embargo on the mechanical working of pillar coal, the industry is making some progress and output has reached a record figure. This has been achieved by mechanization; and the resulting production of more tons per man-shift means cheaper coal to consumers. Some labour displacement is inevitable. Exports of coal have reached 765,000 tons, the highest for 30 years. Five New South Wales collieries have formed an export group to make up long-term contracts for the overseas sale of surplus production in substantial shipments. In Western Australia the black coal position is satisfactory, but the regular heavy loss continues in the Victorian State mine. In Queensland, mechanization is spreading and improvement in the quality of coal marketed is receiving attention.

Output of Victorian brown coal has reached 11,000,000 tons. Expansion of the Yallourn electric power plant has been in

METAL AND MINERAL PRODUCTION

	1955 (000's)	1956 (000's)	1957* (000's)
Gold ..... oz.	1,049	1,030	**1,075**
Silver ..... oz.	14,555	14,586	**15,000**
Lead ..... tons	296	299	**330**
Zinc ..... tons	257	275	**296**
Copper ..... tons	45	52	**54**
Tin, refined ..... tons	2.0	1.9	**1.8**
Tungsten ores, 65% WO_3 ..... tons	2.3	1.6	**1.45**
Coal, black ..... tons	19,275	19,274	**20,500**
Coal, brown ..... tons	10,112	10,560	**11,000**
Iron ore ..... tons	3,572	3,924	**3,700**
Rutile ..... tons	60	96	**120**
Zircon ..... tons	49	72	**85**
Aluminium ..... tons	1	9.1	**10.6**

* Subject to revision.



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progress and construction of the new briquetting plants at Morwell is well advanced; the combined capacity of the two plants will be 1,500,000 tons of briquettes per year.

In addition to the growing increase in coal export from New South Wales, strong hope for the industry is felt through the planning and erection of thermal power stations in several parts of the State.

Manganese

Australia has always been very deficient in manganese reserves, but in the past 18 months tonnages have been increased by 36 per cent. Government policy in permitting some export has stimulated prospecting and general interest so that reserves have now risen to 744,000 tons.

Sulphur

Although about 50 per cent of Australia's requirements of sulphuric acid was produced from local pyritic materials, the position continues to be unsatisfactory to large producers of pyritic concentrate to whom such sales would be an important asset; in particular to Mount Morgan, Mount Lyell, and Norseman Gold Mines, the last named operating solely on pyritic ore, at about one-half plant capacity. Heavy importation of brimstone is severely depressing the market for pyritic concentrates. Further amendment of the Sulphuric Acid Bounty Act, to encourage the use of pyrite, is sought.

Asbestos

There was a marked improvement in the Western Australian crocidolite mining industry, production exceeding 10,000 tons of fibre, most of which was exported. Fibre occurrences are very extensive and are worked by adits into the gorge sides. In New South Wales interest in the production of chrysotile increased and the main producer commenced the erection of a new, modern milling plant. Investigation of another part of the serpentine belt is to be commenced by another large company.

Oil Search

The year has been unsuccessful. West Australian Petroleum Pty. Ltd. has spent £A13,000,000 in the search, and has drilled 184,283 ft. The company and its associates will continue operations in the Kimberley region of the State at an increased rate in 1958. Drilling in South Australia revealed signs of oil but nothing of importance. Drilling has been carried on in North Queensland but has been suspended in Victoria. Exploration for natural gas was carried on in New South Wales. Since the discovery of oil at Rough Range four years ago, £A33,000,000 has been spent in the country by companies and £A1,500,000 by the Government. The Commonwealth Government is granting a subsidy of £A500,000 per year to help the search. In the past 50 years some £A50,000,000 has been spent in oil search in Australia and New Guinea and about 400 holes have been put down.

Problems

The mining industry's problems are centred largely on the heavy fall in the prices for metals and the task of continuing profitable operations or, possibly, being forced to suspend production. Increased output will have some favourable effect upon cost per ton, but the increased volume of product must be sold, and all markets are now congested, while in the cases of all metals but tin, sales for export are essential.

So far, industrial relations have continued to be peaceful but a problem has arisen at Mount Morgan. The company made a profit of only £A29,000 on mining operations in the year and its immediate future depends directly upon the recommendations of the Tariff Board for the help of the copper industry, helped to a lesser extent by consideration of the Sulphur Bounty.

Broken Hill Mines and Mount Isa Mines are faced with a heavy reduction in revenue and profit. Both groups are paying decreasing lead bonus, which had fallen to £9 5s. 0d. per week on the former and £4 7s. 6d. on the latter field for the month of February. Taxation continues to be as heavy a burden as in the past.

Gold mining is still faced with the fixed price for the metal and the position is not easy, despite increased Government aid. Freight and transport charges have increased substantially against all mine products and requirements.

The Outlook

Outlook for base metals in 1958 is discouraging, but unchecked progress can be expected in the development of the aluminium, uranium and steel branches of the industry. Government assistance, as may be recommended by the Tariff Board, may improve the prospects of the copper mining industry and the immediate future of sulphide mineral producers would be helped by favourable revision of the Sulphur Bounty Act in the encouragement of the use of local minerals as a source of sulphur.

The Broken Hill Mines are to cut output by the equivalent of one day per fortnight or 10 per cent and there will possibly be stockpiling of concentrates, which is already being done with zinc; but this may be countered by lower freight rates, if overseas sales are not heavily curtailed. Development in the operating mines will probably be maintained and the great Mount Isa expansion programme is likely to be continued unchecked.

On the gold side, there will be some interest in remoter fields in Western Australia, and plans are in progress for the drilling of the old Mount Morgan gold mine—an attractive objective.

Elsewhere there is unlikely to be any incentive. The Northern Territory and North Queensland offer attractive prospecting fields; iron ore, lead-zinc, copper and tin are being sought, and the search may be expected to continue with rather less attention to uranium. With the growing demand for domestic tin there is scope for prospecting. Beach sands will continue depressed and early relief seems unlikely without large overseas renewal of utilization.

The year should see commencement of uranium oxide production at the Mary Kathleen mine, which is being equipped at a cost approximating £A10,000,000.

Coal could make some further headway, but despite the perturbation of the unions over displacement of men brought about by increased efficiency, there is a move to replace the 40-hour week by a 35-hour week; this would effectively destroy the growing export market and lose more local markets to oil, for it is stated that the proposed shorter hours will increase the price of coal by 6s. per ton.

NEW ZEALAND

GOLD mining continues to wane and has now decreased to two bucket dredges, those of the Arahura and Kanieri companies, which are likely to continue working for some years. Small scale prospecting for gold and other minerals has disclosed nothing important.

During the year it was reported that the Shell Oil Co. was interested in the Taranaki South area and preparations were in hand for drilling to depths of 10,000 or 11,000 ft. Uranium has been located in the Buller Gorge and prospecting was stated to have given some promise of ore in commercial quantity. Further steps were taken in the utilization of geothermal steam for power generation in the North Island.

Attention was again directed to the possible utilization of the extensive deposits of titaniferous iron sands round the New Zealand coasts, and it was reported that experimental work with electric furnaces was in hand with a view to establishing an iron and steel industry.

Coal mining is the major branch of the mining industry but is meeting competition from hydro-electric undertakings.

NEW GUINEA

THE view of the New Guinea mining industry is rather pessimistic. The industry generally has deteriorated and the Administration has been organizing geological exploration and drilling in the search for new mineral areas. The big company, Bulolo Gold Dredging, is now operating one dredge of the original fleet of eight, and this, with a substantial area of ground being worked by hydraulic sluicing, will give several years life. This company, with other gold mining enterprises, is turning attention to timber.

Prospecting for metallic minerals has been unsuccessful in locating commercial deposits. Drilling for oil continues, but the overseas associates of Australasian Petroleum and Island Exploration intend to limit the period of future participation. Heavy gas has again been met in a recent well. The operating companies have a large programme ahead, and Enterprise of New Guinea has now commenced drilling. The mainstay of the mining industry is Bulolo, which expects a fall of 74 per cent in profits.

Surveys of nickel deposits and phosphates are being carried out in New Guinea, Papua and adjacent areas.

FIJI

FIJIAN gold mining has centred round the operations of the Emperor Gold Mines which earned a low profit in 1957 due to increased development footage and substantial increases in costs. Ore reserves were 695,000 tons of 8.7 dwt. ore. Deeper development to the east has been successful in opening up good lodes and more capital is to be raised for increased equipment, power facilities and mill extensions for the exploitation of these ore bodies. Loloma (Fiji) Gold Mines is now an investment company.

TIMOR

THE company which is searching for oil in Timor has spent £A127,000 to June 30, 1957, but progress has been slow.

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THE PHILIPPINES

ALTHOUGH Philippine mineral production for the fiscal year 1956-57 amounted in value to 215,384,126 Philippine pesos, representing an increase in value of 15 per cent over the previous fiscal year, the outlook at the end of 1957 was clouded by the decline in the price of copper and a brake was put on the development of new deposits, especially of low grade with little or no gold content in the ore. Furthermore, because of the reduction in the production of steel in the United States, the demand for chrome and manganese ore also temporarily softened.

About half the total value of mineral production during 1956-57 came from sales of base metals, principally copper, chrome and iron. In 1957, 142,782 l.tons of copper concentrates were shipped from Philippines ports, compared with 115,745 l.tons and 82,396 l.tons in 1956 and 1955 respectively; 700,879 l.tons chrome ore (698,499 l.tons and 594,936 l.tons in 1956 and 1955); 1,362,344 l.tons iron ore (1,363,672 l.tons and 1,450,881 l.tons in 1956 and 1955) and 30,600 l.tons manganese ore (5,408 l.tons and 10,741 l.tons in 1956 and 1955).

Copper is the principal mineral product of the Philippines and about 85 per cent of the country's output comes from mines belonging to Lepanto Consolidated and Atlas Consolidated. Among the smaller producers are the Bagacay Copper Project and the Cabapa Mines. In 1957, the two principal companies produced a total of 33,351 s.tons of copper, an increase of 8,500 s tons over 1956. Drought curtailed production at the Atlas Consolidated's Toledo mine.

President Carlos Garcia is reported to have approved the purchase of machinery and equipment to the value of $U.S.1,500,000 for developing a low-grade copper ore deposit at Bagacay. Philippine producers are said to be busy increasing production in anticipation of later increased demand, but, at the same time, they are seeking relief in the form of reduced tariffs, currency allocations and liberalized barter privileges.

A recent report of the former chief of the mining division of the U.S. Foreign Operations Mission in Manila has predicted that the Philippines will become the principal copper producer in the Far East and that output will be more than doubled in five years. Newmont Mining Corporation is to carry out exploration and development for Atlas. A new company, Apayao Consolidated Mining Corporation, has been formed to mine, mill, concentrate, convert, smelt and refine copper.

PRINCIPAL MINERAL EXPORTS
(in l.tons)

	1956	1957
Copper concentrates	115,745	**142,782**
Chrome ore	698,499	**700,879**
Iron ore	1,363,672	**1,362,344**
Manganese ore	5,408	**30,600**

A total of 611,266 tonnes of refractory chrome ore was shipped during 1957 by Consolidated Mines, Inc., the Philippines' largest producer. This compares with 581,685 tonnes in 1956. Biggest importer was the United States, which in 1957, bought more than 85 per cent of its needs from the Philippines. Other buyers included the United Kingdom, Canada, Japan and Australia. Liberty Chromite Mining Corporation made a shipment of metallurgical chromite to Holland and shipments are expected to be made to the U.S. and Canada. This company is also undertaking the geological study and diamond drilling of several manganese deposits and production is expected to start in mid-1958.

During the year the Philippine Government invited bids to mine and process nickeliferous deposits in the Surigao Mineral Reservation, which is among the most extensive in the world and is estimated to contain up to 52,000,000 tons of mineable ore containing 1.38 per cent nickel in the Nonoc Island alone. The U.S. Bureau of Mines recently estimated that up to 1,000,000 tons of nickel in alloy form might eventually be recovered from deposits in the Philippines if electric smelting proved economically sound. Up to the time of writing, no offers had been received in response to the invitations to bid and the possibility of issuing a new invitation under more favourable terms was being examined. It has been estimated that the exploitation of these deposits would require a capital investment of Philippine $175,000,000.

Palawan Quicksilver Mines, the only Philippine Quicksilver producer, expects that the third kiln for its treatment plant will start operation in June, 1958. This will raise production to about 350 flasks monthly. The bulk of this company's output is shipped to Japan under a long-term sales contract. In recent months, however, 600 flasks, accumulated over contractual commitments, were sold to the U.S.

The demand for Philippine gold bullion remained steady throughout 1957 and in August the Central Bank relaxed further its restrictions on the use of blocked pesos for the purchase of newly mined gold.

INDONESIA

BY the time 1957 had closed the political position in Indonesia had become so confused that it was quite impossible to forecast the outcome. But one could say with confidence that the year was a turning point; things will be very much better or very much worse.

By mid-March the Indonesian cabinet was compelled to resign and in the confusion which followed Sukarno declared martial law throughout Indonesia. Various attempts to form a government followed but all failed and finally Sukarno himself nominated a cabinet with Dr. Djuanda as Prime Minister.

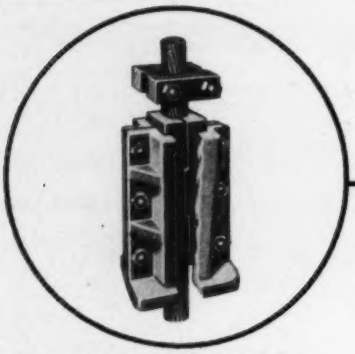
On April 29 the decline in gold reserves had gone so far that Indonesia had immediately to ban the issuing of import licences. In early May it was announced that the U.S. had made a loan of $15,000,000 to Indonesia. Later the concessions of Royal-Dutch Shell were confiscated. Early in 1958 a shooting civil war broke out and it is still being carried on in a desultory fashion.

One of the problems the Indonesians created for themselves was what to do with the tin, which, they declared, could no longer be sent to Holland for smelting. At first it was hinted that it would go to Singapore; but the Indonesians have always regarded Singapore as a capitalist trading centre which would never give the honest producer a square deal. Meanwhile the tin piled up on the wharfs of Tandjong Priok.

In February, 1958, the Indonesian Government issued a statement that in future Indonesian tin would be sent mostly to the U.S. and would be smelted in the Texas smelter; it added that enough tin to satisfy European needs would be smelted in Europe but the whereabouts was not disclosed. The Wah Chang Corporation confirmed the substance but not the details of this report. It will be interesting to see how the Texas smelter works as a commercial unit and whether it is wise to rely on Indonesian ores arriving regularly.

The Billiton Joint Mining Co. has been liquidated as from March 1 because the Indonesian Government wished to end the agreement for joint management of the tin properties on Billiton and Singkep. The properties on Bangka have been government-owned for some years. The consequences of all this for the Arnhem smelter have yet to be assessed. Certainly the Billiton Co. must be regretting not having taken up its option to buy the Texas smelter.

The upshot of all this is obscure. But two things stand out. If the government overcome the rebels they will still have cast away their hopes of investment from the West by their treatment of the Dutch; and if they do not overcome the rebels quickly the Com-



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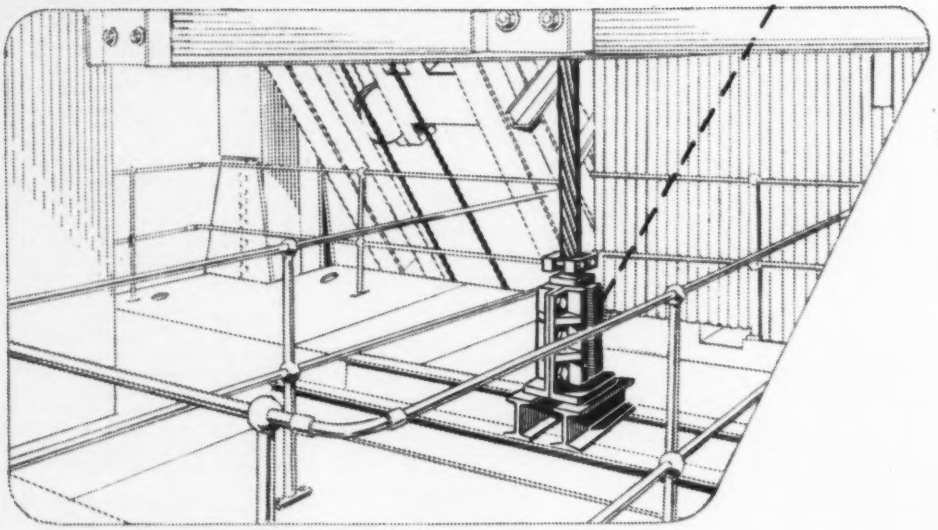

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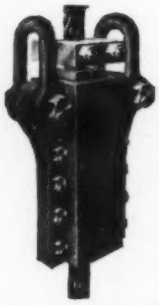

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munists may well seize power. So much for Indonesia. But the action of the Indonesians in seizing Dutch property may well inhibit investment throughout the Far East—particularly in India. And the Indonesians are already coming up against Malaya and Singapore in their attempts first to stop smuggling and secondly to settle their territorial waterways in a way which takes in all the approaches to Singapore.

As to the detail of the progress of Indonesian mining in the past year it is impossible to be precise. The writ of the Government has not run over a large part of Sumatra, where mining is concentrated over the past year. News coming out has been slight. But it is reasonable to infer that development has been almost at a standstill. The International Tin Council reports production at 27,723 l.tons. Production has now been declining steadily ever since 1954 when it amounted to 35,861 l.tons.

The limitations imposed on foreign investment in the basic industries and the total inability of the Indonesian Government to finance development itself make this inevitable. Aid has been promised by Russia and Japan but in both cases it is taking the form of machinery, ships, etc.—not mining investment.

The only capital flowing into the country is coming from America for the oil industry. Caltex has an Indonesian subsidiary which is putting $50,000,000 into Duri oilfield, and a subsidiary of Standard-Vacuum is putting $100,000,000 into the Lurik oilfield and the refinery at Palmebang. The oil companies are anxious to have more freedom of movement to develop reserves, but show no anxiety about their general position in Indonesia.

JAPAN

THE course of the Japanese economy in 1957 may well be seen in retrospect as taking the mining industries of the country into new and significant paths. The significance lies in the fact that 1957 saw the economy raised to new heights of activity and the problem that arose was how to find the mineral resources to keep it going. Japan is looking for them abroad. In fact this is no new solution—there is none other available. But the scale on which the search is being made and the battery of government efforts behind it lift it quite out of the class of anything done before.

Secondly Japan is reaping the benefit of two tendencies; one is that people in the Far East are losing their memories about her actions in the war; the other is that as Indonesia and other countries try to shake off the West they look instinctively to Japan as "one of themselves."

If Japan can somehow raise the capital she will become an exploiter of Far Eastern mineral wealth on an unprecedented scale. Between 1956 and 1960 her self suffiiciency in respect of copper, lead ores and iron ores will decline respectively from 74 to 59 per cent, from 69 to 64 per cent and from 29 to 27 per cent, according to a forecast of the Mine Bureau of Japan. In fact, steel companies are already surveying iron mines around Rulkela and are imposing levies on themselves to finance it. By mid-1957 five joint mining groups had been set up for developing mines abroad. They have already established two iron mining companies in Malaya, a tin mining and a tungsten company in Thailand and a copper mining company in Mexico.

Among the individual firms operating abroad are Mitsubishi Metal Mining at work on the Cheang Phra tin mine; Mitsui Mining and Smelting co-operating in developing Wang Phra and the Khao Kiam tungsten mines in Thailand; Sumitomo Metal Mining seeking to develop Maea Sod Zinc and Lead mine in northern Thailand. In Malaya the Kokan Mining Co. and the Nippon Mining Co. in the autumn of 1957 started raising iron ore from Temangan and Endau; Dowa Mining Co. is established in copper mining in Mexico and will be producing ore in 1959; and there is much activity beside in the Philippines. In August, mining experts arrived in Israel with a particular interest in copper and iron ore. The Nippon Mining Group sent experts to Chile to consider prospects of investing in copper in Antofagasta and Atacama.

Aluminium

In terms of financial years (which run from spring to spring) the Ministry of International Trade has estimated the long range supply and demand for aluminium. In 1957-58 output is expected to be 70,100 tons, and by 1960-61 123,700 tons. Some 288,000 tons of bauxite will be wanted for 1957-59 and 548,000 tons for 1960-61. The imports will come from Malaya, Bintan and Indonesia.

The industry had a worrying year. Stocks of aluminium rose steeply because of the effects of credit restriction, and reached over 4,000 tons at November; in the early months of 1958 they were brought slightly down but as a result of lower output, not higher consumption. Output of primary aluminium actually reached a post-war record in October, but in spite of vigorous efforts the Japanese ran into exporting difficulties as international price cutting began to grow.

Copper

The copper industry misjudged the outlook in 1957. In the early months it was still producing at a very high rate and did not take notice early enough of the credit restrictions. Then came the virtual collapse of the market abroad and the price of scrap dropped badly. It was realized too late that the domestic market had turned weak and that competition abroad was severe: scrap poured into the country because it was cheaper to use than electrolytic and the refineries were in even worse case. In the late summer electrolytic copper went into a landslide. Smelter output was cut by 15 per cent in October and then by another 25 per cent in February, 1958. Output of electrolytic at 142,171 tons was a post-war record and so was the import of copper and scrap at 159,074 tons. By March, 1958, it was estimated that Japan had 15,000 tons (copper content) of electrolytic and scrap in surplus stocks.

Chrome

An offer was made at the beginning of the year for Philippine chrome ore to be turned into low grade ferro-chrome. Nippon Kokan were said to be interested, but the market became surfeited. Chrome ore was on copious offer from India, Pakistan, Turkey and the Philippines as well as the United States, and toward the end of the year Russian ore was also offered. However, demand dried up and the leading chrome manufacturers had to cut output, some by as much as 30 per cent. So demand for chrome ore also fell away and stocks of ore rose to an alarming extent. The surplus was made worse by the reselling of ore by Azuma Kako, Shimura Kako, Nisso Seiko companies, which had intended to go into the business but cautiously withdrew.

Nickel and Manganese

Nickel followed much the same course. Imports were at a high level in the early months of the year, but demand thereafter faded and world markets eased sharply.

The year was also an indifferent one for manganese, but prospects were improved by an American request to process 300,000 tons a year for three years of Indian manganese ores for American use; India to receive surplus agricultural produce in exchange.

Titanium and Zirconium

Cancelled contracts from the U.S. seriously worried Japanese producers of titanium metal because the U.S. normally takes 90 per cent of Japanese output. A professor of Tohoku university was reported to have discovered a new method of refining titanium using titanium tetrachloride and gaseous magnesium; the advantage of this technique is that it avoids the use of American methods, and consequently of royalties.

PRINCIPAL MINERAL OUTPUTS
(In tonnes of refined ore)

	1956	1957
Iron ore	2,006,818	**1,150,000**
Coal.....	46,555,000	**53,699,000**
Copper	77,527	**78,000**
Lead.....	29,597	**33,000**
Zinc.....	122,646	**128,000**
Titanium (sponge)	2,512	**3,078**

The only zirconium producer Toyo Zirconium, had its plant badly damaged by fire in November.

Iron and Coal

As with other ores, the stock position was badly out of line at the end of the year. In the early months there was heavy buying, but later M.I.T.I.'s decision to cut pig iron output by 500,000 tons and a long steel strike in November increased the tendency for stocks to mount; currently they stand at around 3,000,000 tons.

Coal had a reasonable year in that demand was moderately good for most of the time and very good in the early months. In the autumn a strike broke out which spread to the entire industry and, as a result, stocks never became burdensome. In fact, at the turn of the year they were considered comfortable.

Japan now produces about 53,000,000 tonnes of coal and lignite a year. It is planned to increase production to about 65,000,000 tonnes by 1963, but this target seems optimistic.

The Sino-Japanese steel barter contract signed in Peking on February 26 provides for the sale of Japanese steel products in exchange for Chinese coking coal, iron ore and agricultural produce during the period 1958 to 1962.

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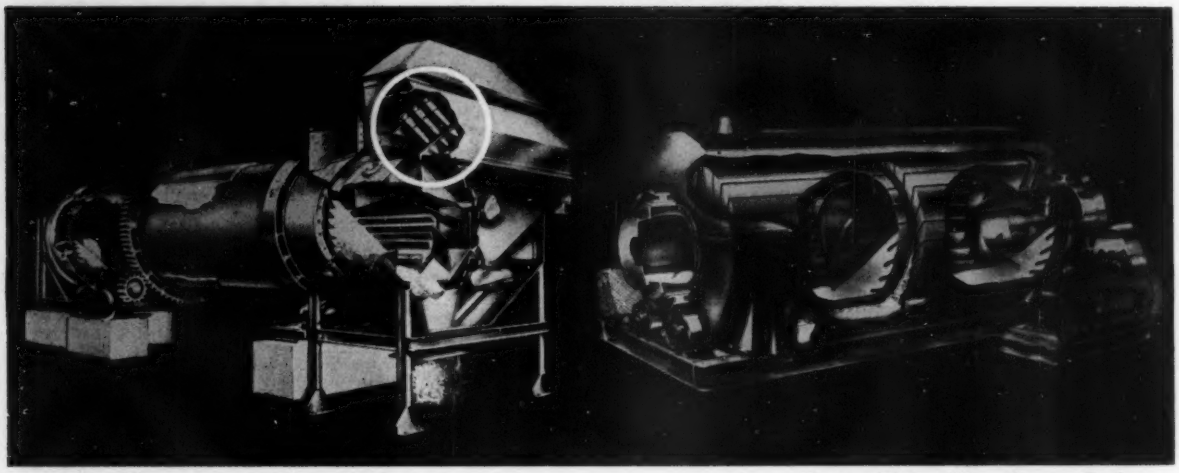

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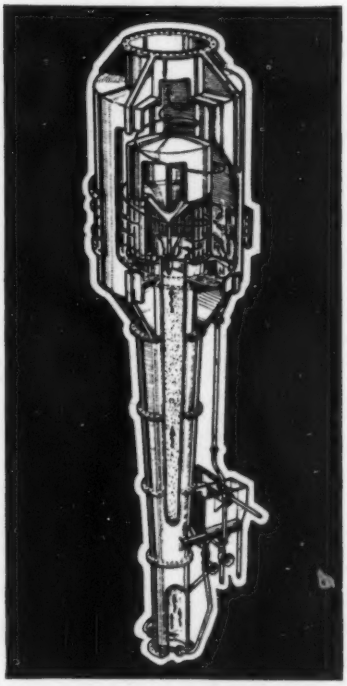

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CHINA *by J. Grindrod*

FOR China, the year 1957 was an important one industrially inasmuch as it marked the end of her First Five-Year Plan (1953-57) and it was a year for re-assessment and for the planning of her second five-year period. Although a complete picture of the fulfiment of the immense programme of economic expansion embarked upon by China is not available, there is no doubt that her output of basic products has increased very substantially. During the first three years of the plan, capital investment showed steady progress, the fourth year saw over-investment, with a resulting reaction in the fifth year and a re-thinking about the planning process. One of the features of this reassessment has been the decision to decentralize much of the country's economic activity, one of the effects of which may be a switching of emphasis from larger to smaller units in mining and quarrying equipment.

Although it seems that the Second Five-Year Plan will include a good deal of stress on agriculture, it is thought that heavy industry, mining, power projects or railways will still have a high priority and increases are demanded, particularly in the production of fertilisers, coal, ferrous and non-ferrous metals, petroleum, salt and soda. The production of copper is singled out as being particularly important.

Following intensive geological prospecting in recent years, considerable mineral reserves are claimed to have been established, including estimated reserves of 29,388,720 tons of manganese, mostly in South China; 2,060,300 tons of tungsten ore, of which a high proportion of the world production comes from China; 631,500,000 tonnes of high and low grade bauxite; 1,873,370 tonnes of tin; and certain not very large reserves of copper in S.W. and N.E. China. Deposits of copper have also been confirmed in Kiangsi, Kansu and Yunnan provinces, while those in Shensi are expected to be the richest in the country. In the latter province some 54 different kinds of minerals were reported at the end of 1957 to have been discovered, including lead, zinc, molybdenum, bauxite, gypsum and coal.

The latest surveys of China's mineral wealth estimate potential reserves of coal at 1,000,000 million tons and of iron ore at 12,000 million tons. Actual workable coal deposits of 32,500 million tons and 4,400 million tons of iron ore are reported to have been located during the past five years. A recent geological survey has confirmed the existence of valuable alluvial gold deposits in Yunnan. Rich mineral deposits, including two iron-ore fields, have been reported from Tibet.

Actual coal production in 1957 was expected to reach 120,000,000 tons, bringing the five-year total to 460,000,000 tons. China now claims to be the largest Asian coal producer and fifth on the world list. China also claims to be able to equip all mines up to an annual capacity of 600,000 tons, and, since 1953, 3,800 workers have been trained in special colliery schools. Twenty-four new pits with a total annual capacity of 7,730,000 tons and two coal washing plants were added to the coal mining plan for 1957 in addition to the 1,650,000 capacity already planned. The Ministry for the Coal Industry recently reported that a new mechanized mine had gone into operation in the Shantan area of Kansu and that a large abandoned mine in Shantung had been restored to partial production. At Haopi No. 4 colliery, hydraulic pressure was being used for coal cutting at a rate of 600,000 tons a year, the shafts having been designed with Soviet assistance.

Steel production in 1957 was expected to reach 5,000,000 tons, of which 2,800,000 tons were produced in plants built with Soviet help. One of the greatest projects included in the First Five-Year Plan was the iron and steel works at Anshan, which, when completed in 1960, are scheduled to produce 2,500,000 tons of pig iron, 3,220,000 tons steel and 2,480,000 tons of rolled steel. China now claims to be able to make over 370 grades of steel and 3,000 standardized items of rolled steel.

It is reported that the Paotow Iron and Steel Co., with Soviet help, is to build a large new steel plant in Inner Mongolia, in conjunction with the development of the Paiyunpo iron ore mines and the adjacent Shihkuai coalfields, and that new reserves of iron ore warrant the construction of 1,500,000 ton plants in N.W. and S.W. China. Approval has been given for the dispersed construction of 18 medium and small iron and steel plants in accordance with the new decentralization policy. Under a barter agreement with Japan, China is to receive steel products in exchange for coking coal, iron ore and agricultural products in the period 1958-62.

Large-scale gold mining has been planned for 1958, especially in Manchuria where the output is to be stepped up to about 14,000 oz. over the year. Three refineries are to be built near Mukden. In South China, Kwangsi province aims at an output of about 70,000 oz. from 34 expanded mines. Gold deposits have also been confirmed in Yunnan and mining is to be started this year. In Hunan province in Central China, gold mining is to be increased six-fold.

During the First Five-Year Plan China invested some £275,000,000 in the petroleum industry. Of the 5,400,000 tons of crude oil produced, 1,500,000 tons were obtained in 1957. Although drilling is concentrated largely in the Yumen and Karamai fields in northern Sinkiang, oil prospecting teams have entered the Takla Makan desert, south Sinkiang, from three sides, and Tsaidam in Tsinghai province is considered to have good oil-bearing possibilities. Other areas in which prospecting is being carried out include Szechwan, Kansu, Yunnan, Kweichow, the Sungiao Plain and Tibet. The Fushan shale oil is expected to produce 67,500 tons of petroleum annually.

In all, the U.S.S.R. is reported to be assisting in the building of 211 major construction projects in China. These are chiefly heavy industry enterprises designed by Soviet engineers and, forming the core of the Five-Year Plan, include steel works, metallurgical plants and coal mines, as well as plants for various other branches of industry. It is claimed that, when these are completed, China will produce all her own equipment for smelting, electric power, mechanical mining and oil refineries, etc.

Targets for production in the sphere of mining and metallurgy under the Second Five-Year Plan 1958-62 adopted by the Eighth National Congress of the Communist Party in China on September 1956, were:

	Unit	*Target* 1962
Coal	10,000 tons	19/21,000
Crude Oil	10,000 ,,	5/600
Steel	10,000 ,,	1,050/1,200
Aluminium Ingots	10,000 ,,	10/12
Metallurgical Equipment	10,000 ,,	3/4

These may be varied in the light of more recent experience.

The estimated new annual production capacity added as a result of industrial projects built or expanded in 1953-57 includes:—coal 52,000,000 tons, pig-iron 2,800,000 tons and steel 2,200,000 tons.

FORMOSA

AMONG the minerals worked in Formosa are gold, silver, copper, coal, sulphur, pyrites, asbestos, mica, talc, serpentine, limestone and clay. In 1956 Formosa produced 2,489,103 l.tons of anthracite, 1,481 l.tons of copper metal, 11,122 l.tons of pyrites, 33,131 oz. of gold and 53,960 oz. of silver.

Aluminium production fell to 8,760 s.tons in 1957 from 9,655 in the previous year. The Taiwan Aluminium Corporation is engaged in a modernization project designed to increase both ingot production capacity and mill and fabrication facilities. The project, which was scheduled to start in 1957, envisages an ultimate reduction capacity of about 20,000 tons a year.

Plans were announced in 1957 for a monthly production of five tons of titanium metal from ore imported from south-east Asian nations.

A new coal mining enterprise, the China Coal Mining Exploration Co., was formed in March, 1957, by the Taiwan Power Co., the Taiwan Sugar Corporation, and the Chinese Petroleum Co. By having their own coal company, these undertakings hope to obviate the recurrent supply-failures of recent years. These failures are attributed to fluctuating government policy, which since 1950 has changed from full control of the coal industry to de-control, and then veered towards semi-control.

The Manchung coal mine will soon be getting from Japan a $U.S.800,000 loan to enable it to buy new equipment; repayment to be over a number of years in shipments of coal amounting to 400,000 tons. The Hsinchu mine may also attract Japanese loans on a similar basis.

SOUTH KOREA

COAL, tungsten and graphite are the main mineral products of South Korea. Other resources include copper, manganese ore, molybdenum, iron ore, monazite, salt, chrysoberyl, columbite and kaolin.

An agreement between the State-owned Taehan Tungsten Corporation, of Korea, and the Continental Ore Corporation, New York, has given the U.S. company exclusive rights for handling the sale of Taehan's tungsten ore for one year at the rate of up to 350 tons a month. During 1957, the Taehan Corporation produced 3,800 tons of tungsten ore, but it has the capacity to mine and process about 12,000 tons of ore a year. South Korea's privately owned small tungsten mines, with a maximum output of about 500 tons a year, will continue to operate on the world market independently.

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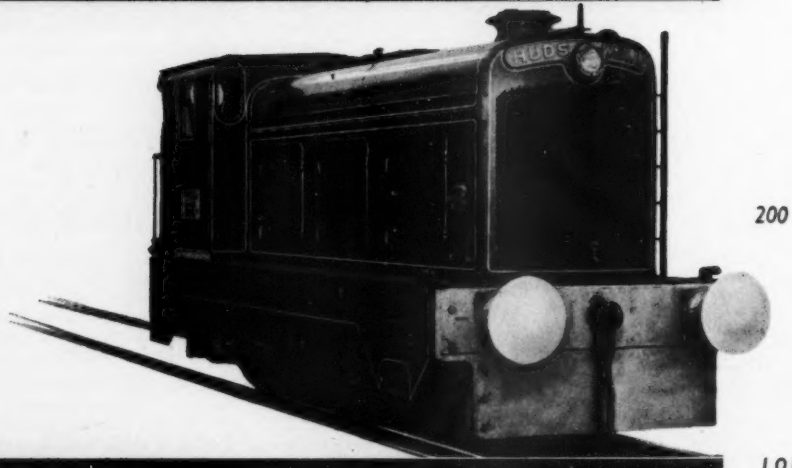

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Several gold mines are benefiting from loans granted by the United Nations Korean Reconstruction Agency (U.N.K.R.A.). Re-equipped with modern machinery, the Songchun mine should produce between 20 and 50 tonnes of ore per day, while the Palkong mine is expected to increase its output from 33 tonnes per month to a possible 100 tonnes.

The Changhang smelter is now refining about 90 tons of copper per month. When the final phase of modernization of metallurgical processes is completed, the plant is expected to increase production to 350-400 tons of copper per month with greatly increased recovery of gold and silver. Production of lead, now being extracted in small quantities, will be expanded to a minimum of 200 tons monthly.

A plan to make the Republic of Korea self-sufficient in coal within the next few years has been approved by the State Council. In 1957 South Korea's coal output amounted to 1,900,000 tonnes. It is expected that the demand for coal will increase over the next 10 years from the present 3,500,000 tonnes to 12,000,000. U.N.K.R.A. and other organizations have given the industry considerable financial and technical assistance in modernizing collieries.

Modernization of the mine operated by Korea Rare Elements Development Co. will increase this firm's monthly output of 80 per cent monazite concentrate from about 20 to 50 tonnes.

In 1956 South Korea produced 50,670 oz. of gold, 196,409 oz. of silver, 3,686 l.tons of tungsten concentrates, 894 tons of copper metal, 2,106 tons of lead ore, 3,596 tons of bismuth ore (bi content), 664 tons of barytes, 3,066 tons of fluorspar, 61,036 tons of graphite, 1,927 tons of manganese, 61,874 tons of iron ore, and 1,773,025 tons of anthracite.

U.S. and Korean engineers will shortly conduct a large-scale search for mineral deposits in the South Korean mountains.

MALAYA *By Our Own Correspondent*

ON August 31, 1957, the Federation of Malaya became a free and independent sovereign member of the Commonwealth. The two British settlements of Penang and Malacca also became States within the Federation. So ended over eighty years of British Administration.

Independent Malaya is unique in having as its new constitutional head a monarch, styled H.M. the Yang di-Pertuan Agong, elected by, and from among, the Rulers of the nine Malay States, to rule for a period of five years.

The transfer of power has brought about no noticeable change in the affairs of the country. The Government continues to pursue the policies of modern democracy, and has demonstrated its determination that in its new and greater responsibility, the stability and economic progress of the country will be its main concern.

In the forefront of Government policy is the attraction of overseas capital for the development of industries by private enterprise. Amongst matters accorded first priority in the Five Year Development Plan is the development of the country's mining industry.

The year 1957 witnessed a substantial improvement in the security position. Communist terrorists, who have been waging a continuous war against authority since mid-1948, have been reduced to hard-core elements, mainly concentrated in the States of Perak and Johore. The Prime Minister, Tunku Abdul Rahman, has declared his intention of ridding the country of the last remaining terrorists before the first anniversary of Independence Day. The intensive nature of military actions gives reason to believe that this intention will be realized.

The removal of all emergency restrictions would open up extensive jungle areas for prospecting. The improved situation in 1957 permitted an extension of prospecting, but the available areas prospected have not produced any sizeable new tin-bearing lands. The most likely areas in which to find alluvial tin are still centres of military operations.

Tin Production

As a country which is the world's largest producer of tin, Malaya's economy is largely dependent on the vicissitudes of the tin mining industry. Thus the decisions of the International Tin Council appointed under the provisions of the International Tin Agreement, of which Malaya is an ardent supporter, are of immense significance.

PRODUCTION OF TIN-IN-CONCENTRATES DURING 1957 BY METHODS OF MINING

	European managed l.tons	Asian owned & managed l.tons	Total l.tons
Dredging	28,117	—	28,117
Gravel Pumping	1,408	22,987	24,395
Hydraulicing	1,620	9	1,629
Open Cast	814	445	1,259
Underground	1,839	681	2,520
Other	1	296	297
Dulang Washers	—	1,076	1,076
Total 1957:	33,799	25,494	59,293
Total 1956	36,100	26,195	62,295

When, in October, 1956, the first contribution to the Buffer Stock was called for from producer country members of the International Tin Council, Malaya was one of the first to pay over her share, amounting to $M.30,223,000. Provision of such a sum would have severely strained the Federal cash reserves, with Independence about to be attained, Government committed to a vast Development Plan, and a costly campaign being waged against militant communists. The transaction was actually financed by obtaining an overdraft from local bankers, which together with the interest thereon, was repaid in full by the tin producers in a period of exactly one year, from October 15, 1956, to October 14, 1957. Repayment was by means of a levy at the rate of $M.24.00 on every picul of tin concentrates sent to the smelters.

The first and second subsequent contributions called for in December, 1957, were financed in a similar manner, and recovery from the producers commenced on January 1, 1958, at the rate of $M.12.00 a picul, since increased to $M.21.00.

When the International Tin Council at its meeting on December 4-5 decided to impose export controls on tin with effect from December 15, Malaya was well prepared. The necessary machinery for internal implementation was contained in Regulations gazetted in 1956, which only required Ministerial notification to bring into immediate effect. After December 15 tin concentrates could only be exported (which in Malaya means passed through a customs control point in transit to the smelters) on a Certificate of Production on which was endorsed the permissible export during the Quota Period.

The Department of Mines performed the prodigious feat of working out a provisional assessment and the quota allotment based thereon for notification to every tin producer in the Federation in time for effect to be given thereto on the appropriate day.

Malaya's share of the world exports of 27,000 tons, permitted during the first Quota Period, December 15, 1957, to March 15, 1958 (later extended to March 31), was 37.5 per cent or 10,125 tons of tin metal. This amount was divided as to 58.66 per cent to European mines; 39.55 per cent to Asian mines and 1.79 per cent to Dulang washers, based on the average production in each section for the past five years. Quota percentages of provisional assessments allotted to producers for the first period were: for European mines 62.25 per cent and Asian mines 64.63 per cent.

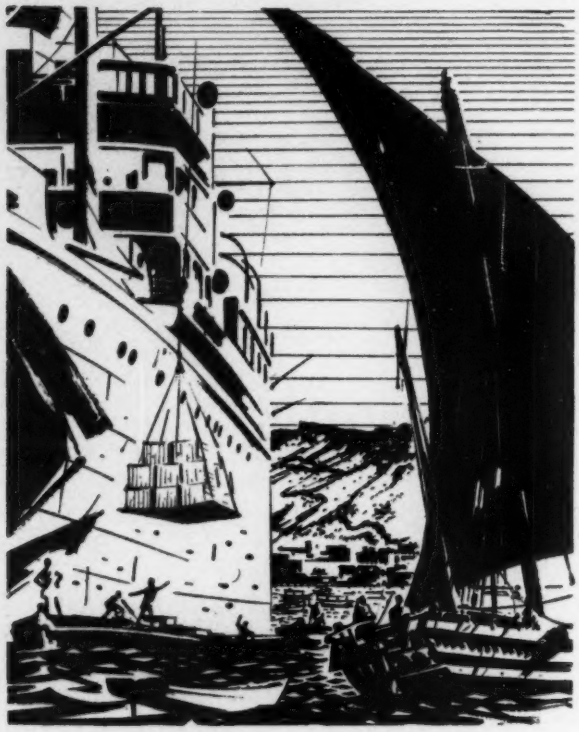
Actual production of 59,293 tons of tin-in-concentrates in 1957 was won as to 57.01 per cent by European mines, 41.81 per cent by Asian mines and 1.81 per cent by Dulang washers.

The number of active producing units in December, 1957, with December, 1956 in brackets, were: dredges 76 (78), gravel pump 597 (633), hydraulic 10 (13), open cast 4 (5), underground 25 (26), others 26 (29), total 738 (784).

The prospects for 1958 are, of course, dependent on the extent to which the control of exports is maintained.

Other Minerals

The table on page 205 discloses that whilst the production of tin-in-concentrates in 1957 fell below the post-



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PRINCIPAL MINERAL PRODUCTS
(In thousands)

		1955	1956	**1957**
Tin-in-concentrates	l.tons	61.2	62.3	**59.3**
Coal	l.tons	206.1	182.4	**152.7**
Wolfram	l.tons	0.056	0.048	**0.03**
Scheelite	l.tons	0.05	0.046	**0.019**
Iron Ore	l.tons	1,466.1	2,444.5	**2,972.3**
Ilmenite (exports)	l.tons	52.8	122.1	**91.7**
China Clay	l.tons	1.3	1.1	**1.5**
Raw Gold	troy oz.	22.8	20.2	**11.1**
Columbite	l.tons	0.0236	0.277	**0.142**
Bauxite	l.tons	222.1	264.4	**325 6**
Monazite (exports)	l.tons	0.249	0.631	**0.490**

war record figure established in 1956, and most of the other minerals also declined, substantial increases were achieved in iron-ore and bauxite outputs.

Japan continued to be the major customer for iron-ore and bauxite, but the 1958 prospect is clouded by a severe curtailment of orders.

Coal production again showed a substantial decline. Representations made during the year to induce the Government to reverse the Malayan Railway's programme of conversion from coal-burning to diesel locomotives were without success.

The production of gold also declined substantially, partly due to a strike of workers at the Raub Australian Gold Mine. This strike started on December 15, 1956, and was not finally settled until May 22, 1957. 610 workers were involved and, during 1957, 86,010 man days were lost. Production in the first six months totalled 3,831 troy ozs. and in the second six months 7,326 troy ozs.

Labour

Labour relations throughout the mining industry during 1957 were good. Apart from the strike at the gold mine already mentioned, there were three strikes in tin mines, in which 1,714 workers were involved and the aggregate number of man working days lost was 11,668. One of the strikes arose from a dispute over wages, one was caused by the dismissal of a worker and the other was a sympathy strike.

The Malayan Mining Employers' Association recognizes the All-Malayan Mining Industry Staff Union and the Malayan Mining Employees' Union, with both of which organizations discussions and negotiations take place on an ad hoc basis. There is a third trade union, the Mining Workers' Union of Malaya, which has not yet received recognition by the employers' Association but has made some progress during the past year, particularly amongst the workers on Asian mines, hitherto considered stoney ground for trade unionists.

THAILAND *by Our Own Correspondent*

ONE of the two events of outstanding interest to the mining industry of Thailand during 1957 was the bringing into effect, on February 27, of a Labour Act, the main objects of which are to restrict the labourer's working week to 48 hours and to provide compensation for injuries at work and for occupational diseases.

The other was the rather belated ratification of the International Tin Agreement.

The Tin Industry

Thailand's ratification of the International Tin Agreement, of which it was one of the original signatories, was delayed owing to difficulty in arranging the finances required for Buffer Stock contributions. These were eventually overcome, and the documents of ratification were deposited on March 18, just in time for Thailand to make the cash payment of the first contribution at the original floor price of £640 a ton, which on a contribution of 943.5 tons saved £84,915 against the amount which would have been payable at the increased floor price of £730 a ton agreed at the Fourth Meeting of the International Tin Council on March 20-22.

Buffer Stock contributions are recoverable from tin ore producers at a levy of £2 a picul of tin concentrates and £3 a picul of tin metal.

Production of tin-in-concentrates at 13,530, l.tons was the highest since 1941, being 1,049 tons in excess of the 1956 figure.

Thailand's share of the permissible total world exports of 27,000 tons for the period December 15, 1957, to March 31, 1958, was 7.35 per cent, or 1,985 tons, which represented a production cut-back of approximately 39 per cent.

At a meeting between tin miners and the Director General of the Mines Department, in Bangkok, on December 14, it was decided that mines would be permitted to continue normal production to the end of December to enable the Mines Department to obtain data on which to base quota allocations to individual mines. The amount produced in the period December 15 to December 31 would be offset against the quota.

The effect of this decision was that when quotas were subsequently notified there was very little balance left to produce. In Bhuket all dredges except Aokam Tin were closed down by the end of January, 1958, having completed their production quotas for the first period.

In March, Aokam Tin commenced production with their new grab dredge, which introduced an entirely new technique in recovering tin from the seabed. The not inconsiderable teething troubles experienced in practice appeared to have been substantially overcome by the year end, and the directors have announced their belief in the ultimate success of the undertaking.

Development work on the hard-rock Chon Mine has continued, but, owing to communication difficulties progress has been slow. A new approach road is under construction.

The Bhuket Dredge of Tongkah Harbour Tin Dredging Ltd. broke its ladder during a heavy swell in July, and was under repair for the remainder of the year.

A new Association, representing British and Commonwealth Mines in South Thailand, was registered in Bangkok, towards the end of the year, under the title of the Association of British Mines. Member mines contribute some 45 per cent of the total Thai production of tin concentrates. The new Association will enable closer liaison between the mines and the Government.

Other Minerals

There was a sharp drop in the production of wolfram concentrates (65-74 per cent WO_3) from 1,162 l.tons to 890 l.tons. The Government reduced royalty fees to enable mines to continue in operation in face of poor world prices, but even so some mines have closed down and others are working on a marginal basis only.

Production of antimony during 1957 was negligible, only amounting to 3 l.tons against 73 l.tons in 1956.

Lead production declined from 9,285 l.tons in 1956 to 7,118 l.tons in 1957. There is no present indication of any improvement.

Production of iron ore in 1957 was the highest on record, at 8,833 l.tons, compared with 5,684 l.tons in 1956. The Government is anxious to develop a local iron and steel industry which would give impetus to iron ore production. Experts from Krupps are carrying out surveys and co-operating with the Ministry in the preparation of specifications. A local Thai group has obtained a 99 year lease over areas in North-East Thailand, with the object of exploiting iron ore deposits in that region.

The import of gypsum is now prohibited, in order to facilitate the development of the Damnern Gypsum deposit in Central Thailand, exploitation of which was commenced early in the year by the Thai Gypsum Co. Efforts are being made to develop export markets.

The exploitation of manganese commenced in 1956, when 401 l.tons was produced; it continued in 1957, but production fell to 340 l.tons.

Development work continued in the oilfield in the Farng area of Northern Thailand. A pilot refinery is being constructed. Further surveys have been undertaken in the Central region.

CAMBODIA

THE Phnom Dek area has been opened for gold prospecting and mining to the local inhabitants at their request. The purchase of gold being reserved to the Cambodian Government, a co-operative association has been organized to buy the production.

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BURMA

THE objective of Burma's development plan—the "Pyidawtha"—is that by 1959-60 the country's inhabitants shall be producing nearly one-third more than before the war. Due to a heavy fall in the export price of rice, however, some projects requiring heavy expenditure of foreign exchange have had to be deferred. Failure to deal with insurgency as rapidly as was hoped has been another unfavourable factor. Government planners now think that industrialization is more likely to take 40 years than the five to 10 years originally envisaged. A four-man mission of the International Bank for Reconstruction and Development is at present in Burma. Its objects appear to be a reassessment of various Burmese development plans.

Mineral production suffered heavily as a result of the war and subsequently of insurgency, which is adversely affecting transport and thereby handicapping some of the mining ventures. Nevertheless, despite all difficulties, some progress has been made in the rehabilitation of the mining industry. The Government seeks to encourage foreign and domestic capital to play an increasing part in the development of Burma's mineral resources. Expenses incurred by firms in connection with the exploitation of mineral and oil resources will no longer be liable to income tax. A new foreign investment law is under preparation and it has been stated that guarantees against nationalization, valid in the case of some industries up to as long as 20 years, may be granted.

Development of the mining industry is to be undertaken in three sections: by the state, by joint ventures between the Government and private enterprise, and by private enterprise. The Government has announced that it will undertake only those sections of the industry which cannot be handled by private enterprise, such as the production of coal and iron and the development of minerals in remote places where the private investor would be chary of operating.

There is much optimism in Burma regarding the prospect of American investment in the mining industry, following a U.S. trade mission early in 1957 and a conference held later in Washington to discuss possibilities for developing the country's mineral resources.

"Pyidawtha" originally provided for seven mining projects, of which one has been dropped from the schedule, two had been completed partially or on a reduced scale by January, 1957, and four are under implementation.

The Mineral Resources Development Corporation, responsible to the Ministry of Mines, is in charge of two main projects; a tin and wolfram mine at Yadanabon-Namyen and the development of deposits of sub-bituminous coal at Kalewa. Production at the Yadanabon mine, close to the Thai frontier, has been handicapped by local insecurity, transport difficulties, and failure so far to devise a suitable working plan, but there are prospects of good results.

The short-term plan at Kalewa is to produce 100 tons of coal a day, but it is hoped to raise output after four or five years to 1,000 tons a day or 300,000 tons a year. A British firm of consultants has been engaged to advise on production. This project is of great importance to the Government's plans for an industrial area in Central Burma and for the development of the steel industry.

Apart from petroleum, the most valuable minerals to Burma's economy are the lead-zinc-silver group from the Bawdwin mine in the northern Shan State, which was probably the world's largest lead mine before the war. Rehabilitation of this mine is being undertaken by the Burma Corporation (1951) Ltd., in which the government of the Union of Burma and Burma Mines Ltd., of London, hold equal shares. In 1956 the joint venture showed a profit of £529,000, but profits have since been adversely affected by the reduced prices of lead and zinc.

At the Mawchi Mine, in the Kayah State, Burma's largest tin and tungsten producer, the recovery of production has been hampered by the presence of insurgents and by labour shortages, but over the first 11 months of the current financial year output totalled 562 tons of mixed concentrates, compared with 242 tons in respect of the full year to March 31, 1957.

The Anglo-Burma Tin Co. Ltd., another joint venture company, has a mine at Heinda in the Tavoy district estimated to contain at least 5,600 tons of metallic tin. This company has been continuing tributing operations and preparatory work at the old company's former properties. In the financial year ended September 30, 1957, it produced 121 tons of tin concentrates (1956: 88 tons).

Of the other British companies, Tavoy Tin Dredging is restarting dredging at Theindaw on the Great Tenasserim River and is also mining on a small scale in the Tavoy district. Consolidated Tin Mines of Burma are at present working through tributors.

A new refinery completed early in 1957 will make Burma self-sufficient in motor petrol and paraffin. Oil drilling is taking place at Ondive in the Magive district of Central Burma. Gas has been struck at various levels.

An aerial survey contract to photograph 200,000 sq. miles of territory in Burma was won by Fairey Air Surveys Ltd., of London, and its associated company, Air Survey Co. of India (Pte.) Ltd., The contract is valued at £200,000.

A Yugoslav team of prospectors is reported to have found a rich deposit of ilmenite near Sumprabum in the Kachin States.

A mining school has been set up within the Insein Technical Institute, about 12 miles north-west of Rangoon. There are at present 53 students. In addition, young Burmese continue to be sent overseas.

INDIA

INDIA'S programme of mining and industrial development is dominated by the Second Five Year Plan, under which firm commitments requiring £1,000 million of foreign exchange have been made. The Plan is an attempt to raise the very low standard of living of the Indian population. It has resulted initially in an acute shortage of foreign exchange, which has been alleviated to some extent by a credit of 500,000,000 roubles from the U.S.S.R., an offer of economic aid totalling $290,000,000 from the U.S., extended credit from Western Germany, and increased withdrawal of sterling balances. Substantial aid is also being extended to India under the Colombo Plan.

In view of the shortage of foreign exchange, relaxation of India's Industrial Policy resolution is to be permitted, particularly in regard to prospecting and exploitation of minerals. State Governments have accordingly been requested to allow private interests to undertake mining in respect of some minerals hitherto reserved for the public sector.

The Government of India is understood to have decided to fix a ceiling of 50 sq. miles on the area for which prospecting licences in respect of any mineral or prescribed group of associated minerals can be granted to private parties in any one State.

Coal, Iron and Steel

The expansion of steel production is being given high priority in the Second Five-Year Plan, the aim being to bring domestic output abreast of demand by the end of March, 1961. A large part of this expansion is to be achieved by programmes undertaken with World Bank support by the two privately owned steel companies, the Tata Iron and Steel Co. Ltd. and the Indian Iron and Steel Co. Tata has received a loan of $32,500,000 to help complete an expansion programme aimed at doubling its ingot producing capacity, which is to be raised to 2,000,000 tons annually.

The construction of steel plants in the public sector is proceeding and the capacity of all three projects has been raised.

Discussions have been held in Washington on financial assistance for a joint project by India and Japan to develop rich iron ore deposits in the Rourkela district or elsewhere in eastern India and to improve railway facilities to the port of Vishkhapatnam. Japan would get an additional 2,000,000 tons of iron ore from this new source by about 1962, thus doubling its present ore imports from India. It is hoped that the bulk of the financing can be achieved through a U.S. loan.

Earthmoving operations started in May, 1957, at the 200,000,000-ton Neiveli lignite deposit in Madras State, which is being developed by Neiveli Lignite Corporation (Private) Ltd., a government organization, at a projected cost of $U.S.147,000,000. The deposit will be worked by open-cast methods. By the end of 1958 the first of four large excavators will be ready for operation. Once lignite is being produced, the Indian Government will construct a thermal generating station near the pit.

Manganese, Mica and Chromite

India has very large deposits of high and low grades of manganese ore, which are mined to the extent of more than 1,000,000 tons a year, mainly for export. Reserves are estimated at about 120,000,000 tons. In 1957, exports amounted to 954,832 l.tons, compared with 700,922 tons in 1956. The system of quota-licensing of manganese ore for export was continued for the period July, 1957-July, 1958. It was announced that from July 1, 1957, an increased share of manganese ore exports, as well as all shipments of iron ore, were to be canalized through the State Trading Corporation. At the beginning of 1958, the Indian Government abolished the export duty on manganese ore of less than 42 per cent grade and reduced the duty to Rs.10 a ton on ore of 42-44 per cent manganese content.

The manganese mines at Joda in Orissa have received high priority for expansion, the reason being the expansion programme of Tata Steel at Jamshedpur. The new ferro-

manganese plant at Joda will have an initial capacity of 30,000 tons a year and is being designed so that output can be stepped up to 100,000 tons a year.

Pilot plants for improving the quality of low grade manganese ore are to be set up in India as a joint venture of private enterprise and the public authorities. The plants will raise the present grade of 30-38 per cent to 46-48 per cent.

India is the largest producer of mica. In the first half of 1957 exports totalled 14,099 l.tons compared with 24,233 tons in all 1956. The number of active mines in South India has dwindled from 144 in 1951 to 40 in 1957, due to lower purchases by the U.S., which is the biggest consumer of the various categories. The Government of India and the State Governments are being urged to start electrical industries to consume mica. The National Council of Economic Research has recommended the establishment of a mica grinding plant of 1,000 t.p.a. initial capacity, which would allow India to market mica in ground form.

A Bill providing for a system of licences and permits for controlling the sale and transport of mica came before the Andhra Pradesh Legislative Assembly in April, 1957.

Steps are being taken by the Government of India to ascertain whether deposits of iron ore and chromite in the Salem district in Madras State are large enough to warrant large-scale exploitation.

The production of chromite in India during the period Jan.-Sept., 1957, was 56,794 tons against 40,215 tons in the corresponding period of 1956. In terms of Cr_2O_3 content the 1956 output amounted to 25,300 tons.

Non-Ferrous Metals

Aluminium is the only major non-ferrous metal in respect of which India has extensive known ore deposits. The total known reserves of bauxite are estimated at 250,000,000 tons, of which about 27,000,000 tons are suitable for the production of metal.

There are two concerns currently producing aluminium in India, and at present their combined installed capacity is about 7,500 tons a year. Requirements, currently estimated at about 25,000 tons a year, will reach 35,000-40,000 tons by the end of the Second Five-Year Plan. A production target of 40,000 tons, regarded as a minimum, has been set. Two new licences have so far been issued; one for a new unit of 10,000 tons at Hirakud and another for expansion of an existing unit to 5,000 tons. A committee of experts has recommended the establishment of two smelters, each of 10,000 tons capacity with facilities for expansion up to 20,000 tons. Mettur and the Rihand Dam were proposed as suitable sites.

Early in 1958 it was reported that the Bombay Government was examining the possibilities of setting up an aluminium plant of about 20,000 tons annual capacity near Kolhapur in Bombay, where abundant bauxite deposits have been located. It was further stated that an aluminium plant which it was proposed to set up in Madhya Pradesh might be located either in Katni or Amarkantak. The latter site was recommended by a French expert who carried out a detailed survey of the bauxite areas.

Known workable deposits of copper ore are confined to the Singbhum copper belt in Bihar. During Jan.-Sept., 1957, production of copper ore was 299,723 tons. Annual production of copper metal is about 7,200 tons per annum, while demand has been estimated to be in the grgion of 25,000-30,000 tons.

The position of the lead industry is very similar, the only commercially exploitable deposits being the lead/zinc ores of the Zawar mines near Udaipur in Rajasthan, which are worked by the Metal Corporation of India. Total output of lead/zinc ores during 1957 was 95,462 tons (79,959 in 1956.) Present production of lead is about 2,400 tons annually. Demand is increasing very rapidly and by the end of the Second Plan period may have reached 20,000 tons. It was expected that by the end of 1958 the existing producer would be operating its lead smelter at a capacity of 6,000 tons of lead.

The Indian Bureau of Mines has started proving operations for copper at Khetri and Daribo and is about to do so for pyrites at Ajmer.

Radioactive Minerals

Steps are being taken to produce in India all the materials required in the production of power from atomic energy.

At a meeting of the United Nations Economic Commission for Asia and the Far East (E.C.A.F.E.), a report from the Indian delegation outlined the occurrence of uranium and thorium in Rajasthan, Bihar, West Bengal, Madras and Kerala, and described deposits of heavy mineral sands containing thorium. The Indian Department of Atomic Energy has made an initial

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exploration of the shallow seas off the Kerala coast, proving the existence of mineral sands on the sea floor.

A heavy water plant is being established at Nangal and it is proposed to set up a pilot plant to produce beryllium oxide.

Diamonds

A corporation with a capital of Rs.20,000,000 is to be set up for working the diamond mines in Panna, Madhya Pradesh, which will be nationalized. Mechanization of production is proposed.

Other Minerals

India's reserves of ilmenite and rutile sands are estimated to be of the order of 300,000,000-350,000,000 tons. In 1956, 336,000 tons of ilmenite and 541 tons of rutile were produced.

India is also a large producer of high quality kyanite, an output of 20,135 tons being recorded in 1956. Exports are restricted to about 20,000 tons annually.

PAKISTAN

MINERAL resources have so far played a minor role in the economic development of Pakistan. Apart from encouraging foreign participation in exploring for petroleum and exploiting the natural gas field discovered at Sui in West Pakistan in 1955, little was done during the country's first decade of independence toward developing minerals of economic importance. In 1956 the value of mineral production was about Rs.62,359,000, of which Rs.34,953,000 came from crude petroleum and Rs.6,359,000 from natural gas.

On the basis of known deposits and probable reserves, the Government of Pakistan recognizes that the country's mineral resources could be exploited to a far greater extent. Recent surveys have shown that Pakistan is rich in minerals of many types. Under the Five-Year Plan, the estimated cost of developing fuels and mineral supplies is given as Rs.457,000,000 of which private industry, principally petroleum, is expected to contribute Rs.365,000,000.

Effective January 1, 1957, certain powers were transferred from the Central to the Provincial Governments. The Central Government retains control over petroleum, natural gas, iron ore, manganese, tungsten, vanadium, and all minerals required for the production of nuclear energy. All other minerals passed into the control of the Provincial Governments.

The Department of Petroleum and Minerals is under the Central Government's control, as well as the Atomic Energy Commission. The offices of the Chief Inspector of Mines and the Salt Administration have passed to the Provinces, and regional coal controllers function in Lahore and Dacca.

In East Pakistan comparatively few minerals of economic importance have been found. In West Pakistan the Rs.10,000,000 Mineral Development Corporation will sponsor and float private companies for the exploitation of mineral deposits.

Since 1903 nearly 800,000 l.tons of chromite, averaging 47 per cent chromic oxide, have been mined in Hindubagh in the Zhob district of Quetta Division. Unmined reserves are believed to exceed 60,000 tons. Deposits in the Chagai district have reserves estimated on surface evidence at 17,000 tons with chromic oxide content of 35-53 per cent. Other occurrences are known. Before partition, chromite was mined exclusively by a British company, the Baluchistan Chrome Mines Ltd., which changed its name in 1951 to Pakistan Chrome Mines Ltd. This company and Pakistan Industries Ltd., which mine about 75 per cent of all the output, recently amalgamated their Hindubagh holdings under the name of Pakistan Chrome Mines Ltd.

Chromite production over the past five years has averaged about 22,600 tons per year. About 75 per cent of the chromite production is by underground mining, the remainder being by open-cast. Output could be greatly increased if producers were able to import the necessary equipment and were serviced by all-weather roads. Production of the amalgamated Pakistan Chrome Mines Ltd. was expected to be 13,000 tons in 1957. An output of 24,000 tons was hoped for in 1958.

Coal production in Pakistan is in the region of 600,000 tons a year. The Government is planning the extensive mining of coal in the Quetta and Kalat Divisions.

In the first three-quarters of 1957 the output of natural gas amounted to 8,059 million cu. ft.

The Pakistan Industrial Development Corporation, with Krupp-Technik, has been conducting prospecting operations and preliminary development of three iron mines near Kalabagh in Mianwali District to meet the requirements of a proposed steel mill utilizing the Krupp-Renn process. The ore has an iron content averaging 34 per cent and SiO_2 content averaging 21.5 per cent. The possibility of beneficiation is being investigated by the Government. The Geological Survey of Pakistan places the total workable reserve at 35,000,000-40,000,000 tons, of which only about 2,000,000 tons are proved. It was proposed to resurvey the deposits on a large scale.

Recent surveys in the Quetta and Kalat regions have revealed deposits of chromite, high-quality iron ore, copper, and manganese ore, as well as indications of gold in the Chagai district. Other minerals discovered in West Pakistan include vermiculite, fluorite, barytes, scheelite, asbestos, and colombite tantalite. Deposits of lead ore covering some 200 acres were found in 1957 between Gilgit and Chitral.

Uranium deposits reported to be of high quality have been discovered in the Hazara district of the North-West Frontier province.

CEYLON

THE chief mineral products of Ceylon in 1957 were graphite and gemstone.

The downward trend in the graphite mining industry in the Island, which was noted in previous years, continued further during 1957. There was a further drop in exports of about 11 per cent as compared with that of the depression days of the early thirties.

The larger mines worked continuously throughout the year on a restricted production basis. All the mines are holding large stocks of graphite for which there is no market.

The unprecedented rains at the end of the year resulted in very heavy inflow of water in the large mines in the Kurunegala district adding considerably to the difficulties already existing. The small mines are gradually going out of production and the number working at the end of the year was the lowest in recent years. The small mines have no machinery installed and are all worked by manual labour. They are adversely affected by the wage regulations which are more suited to mechanized mines.

The principal graphite mines continue to be worked by Bogala Graphite Ltd., the Kahatagaha Mines Co. Ltd., and H. L. de Mel and Co. Ltd.

The total quantity of graphite exported from Ceylon during 1957 was 8,190 tons valued at Rs.5,945,100 as compared with 9,207 tons valued at Rs.6,210,510 exported in 1956. The average price was Rs.726 per ton as compared with Rs.675 in 1956. The higher average is due to the fact that the high grades only were exported.

The following are the export figures from 1951 to 1957:

Year	*Tons*
1951	12,261
1952	7,659
1953	7,218
1954	7,755
1955	9,879
1956	9,207
1957	8,190

No figures for the production and value of gemstones are available. However, gemstone mining continues and it may be estimated that about Rs.1,500,000 worth of gemstones are produced annually.

The principal varieties produced are the ruby, sapphire and its star varieties, cat's eye, zircon, topaz, aquamarine and moonstone.

The experimental plant for the recovery of monazite from beach sands, specially at Pulmoddai near Trincomalee on the east coast of the island, continued to work throughout the year.

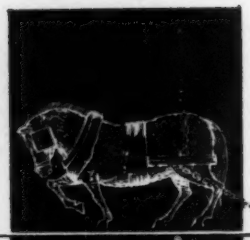
Due to lack of machinery, only two grades of monazite assaying 70 per cent rare earth oxides were produced. A stockpile of about 225 tons of No. 2 grade monazite awaits further treatment. At present a magnetic separator is on order.

No mica was mined or exported from Ceylon during 1957.

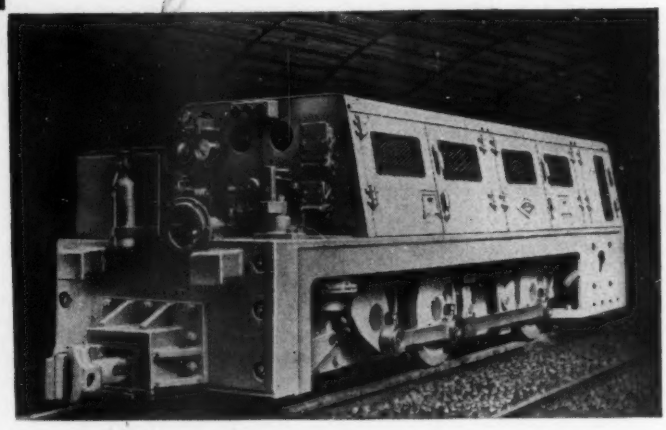
GOA

FURTHER increases in exports of iron ore and manganese from Goa were recorded for 1956, the latest year for which statistics are available. Iron ore exports rose to 2,014,444 l.tons from 1,498,052 tons. Exports of manganese ore totalled 162,000 tons, a figure well above the levels established in the two preceding years, although below the record total of 207,361 tons reached in 1953.

A few years ago Japanese financiers entered into agreements for the exploitation of iron ore mines in Goa and much Japanese capital has been sunk in the development and mechanization of some of the iron ore mines. Japan has now stopped all imports of iron ore from Goa, this action being taken primarily to facilitate the conclusion of an agreement with India for the importation of iron ore from the latter country. Assurances were given that India was in a position to make good the iron ore supply that Japan had been receiving from Goa.



power in harness



A Crossley-engined "Miner" locomotive, with acknowledgements to North British Locomotive Co. Ltd.

Still in harness, after decades of faithful service in mines and collieries, the pit pony has nevertheless slipped out of vogue. No matter how hard he strains, no matter how uncomplainingly he hauls his load along, he, like the plough horse, can never hope to match the forward march of mechanisation. He is being supplanted by the mining locomotive. Today, in many places, mining locomotives are performing the tasks formerly entrusted to the pit pony. Powered by Crossley Diesel Engines, they, like he, pack a maximum of strength into a minimum of room, but on an even more impressive scale. Crossley Brothers have solved many problems in the vast field of diesel operation, both on land and sea, with their compact diesel power. They will continue to do so in the future.

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Middle East

ISRAEL • EGYPT

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ISRAEL

IN the draft budget, totalling approximately £233,000,000 sterling and submitted to the Israel Parliament for the fiscal year beginning April 1, 1958, a sum of about £6,500,000 sterling has been earmarked for the exploitation of mineral resources. This figure does not, of course, include many other important items which to a large extent also affect mining development projects, such as expenditure for electricity (estimated in the budget at some £7,000,000 sterling). Considerable sections of the plans concerning the mining industries will, in turn, centre around the principal schemes in which, for some time already, all Development Corporations of Israel have actively been participating. In these essential corporations the Government in holding from 50 to 100 per cent of the capital.

The copper plant at Timna in the Southern Negev, not far from the port of Eilat, an enterprise of the Israel Mining Industries, has begun its six months running-in period. When full production is finally started in the second half of 1958, the factory will employ 280 workers. It has so far required a total investment of about £5,500,000 sterling, of which nearly £4,000,000 went for installations and equipment and the rest for working capital and developing the ore.

According to a report prepared by the Ministry of Development, the profitability of copper production at the Timna works, with an annual capacity of between 8,400 and 12,000 tons of copper cement (75 per cent copper), will be conditioned by two factors: the world price of copper and the average content of the ore. Timna ores have an average content ranging from 1.4 to 2 per cent. The authors of the report forecast an average price of $600 during the current year. They also propose that serious consideration should be given to the possibility of doubling the capacity of the present installation, in which case a plant to refine the local copper cement electrolytically may, perhaps, prove a commercially sound project. An adequate expansion would necessitate an additional investment of some £3,000,000 sterling which, in the opinion of the report, could be accumulated through the plant's profits.

Early in 1957, the bromine extraction plant, owed by the State (Dead Sea Bromine Co. Ltd. with Head Offices in Jerusalem), was put into operation. The company has exported the whole output to manufacturers of bromide and dyes in the U.K., Belgium, the Netherlands, Western Germany, Italy, Switzerland, Denmark and Poland. The company expects to increase its output considerably this spring. Other important Dead Sea minerals, such as magnesium, are still awaiting exploitation.

The Dead Sea Works Ltd., Beersheba, report that in 1957 production of potash reached some 80,000 tons. There are plans under way to raise this output to over 100,000 tons in 1958 and to improve further productive efficiency.

There are, too, good prospects in the ever increasing output of the Negev phosphate industries, in spite of a number of difficulties and losses in past years. In 1956-57 output rose to 114,000 tons (only 16,500 tons in 1952-53) and it is expected that the figure for the current fiscal year will be 160,000 tons. Future plans envisage the production of pure phosphate from the phosphate rock which, as a high-grade fertilizer, will achieve good prices on world markets. The production of metaphosphate will also be undertaken.

Apart from some promising signs of oil, lately found in the northern part of the country and under investigation by geologists, actual results in respect of oil discoveries have been confined to the Heletz area where production in 1957 amounted to 63,000 tonnes. By the end of 1957, 5 per cent of Israel's oil consumption was being supplied by the Heletz oilfield.

EGYPT

ENCOURAGING reports continue to be received from Egypt regarding the progress of mining and exploration. In the light of frustrations experienced in the past by companies interested in the exploitation of Egypt's oil and mineral resources, it is possible that some of the statements emanating from Cairo may tend towards over-optimism.

According to an official of the Ministry of Industry, the implementation of a number of mining programmes which have been proposed would add almost £E4,000,000 to the national income. These projects include plans for the exploitation of manganese, iron ore, phosphate, salt, zinc, lead, tin, black sands, ilmenite, chromite, graphite and other mineral deposits. The total value of mineral ores produced by Egypt in 1956 was £E1,538,000. The Ministry of Industry has allocated £E12,530,000 for mineral prospecting during the next five years.

Average monthly production of manganese ore by the Sinai Manganese Co. during 1957 was 10,000 tons. It was expected that output would be stepped up to an annual rate of approximately 250,000 tons by the end of 1958. Geological missions at work in the Sharm-el-Sheik area in the south of the Sinai peninsula estimated that 100,000 tons of manganes ore could be produced annually in that area. The Ministry of Industry decided to set up a company with a capital of £E500,000 to exploit these deposits.

The most recent discoveries include zinc and lead finds at Om Gheig. Egypt's imports of these two minerals are estimated at £E250,000 annually.

Plans are in preparation to exploit deposits of copper ore which have been found in several districts. Recent discoveries in the Sinai Peninsula are understood to be substantial. Prospecting is still in progress.

Coal in veins up to 4 ft. thick is reported to have been found at a depth of 1,500 ft. near Moses Wells in the Sinai Peninsula 35 miles south of Suez.

In September, 1957, a Presidential Decree authorized the Economic Organization, a Government agency, to form a joint stock company to be known as the Société Generalé d'Ilmenite, S.A.E. With a capital of £E500,000, the company will conduct mining operations in general, with special reference to the extraction of ilmenite. Only Egyptian nationals may become shareholders.

The iron and steel plant under construction at Helwan is nearing completion. It will process iron ore from the mines at Aswan.

After various reorganizations and changes of name, the Oriental Oil Co. was formed during 1957 to search for oil, 49 per cent of the company being Egyptian owned and the remaining 51 per cent belonging to the International Egyptian Oil Co. in which the Italians hold a controlling interest. The management and almost all the technicians are young Italians. The operations of this company resulted in the discovery of new fields at Belayim, Abu Rudeis and Ekma. A much larger drilling programme is planned.

In August, 1957, a new concern named General Oil Co. was formed. Supervised by the State Economic Organization, it has been granted prospecting rights in 61 areas in the eastern desert, Sinai and the Red Sea zone. Prospecting licences for these areas had formerly been sought for several years by Anglo-Egyptian Oilfields and Mobiloil.

JORDAN

EARLY in 1957, the Jordanian Phosphate Co. was granted permission to export 450,000 tons of phosphate during the year to Europe and the Far East and it was expected that the quantity to be exported during 1958 would be still greater. A much larger output is regarded as justified by the proved reserves if the transport position could be sufficiently improved.

In October, 1957, it was announced that a 10-year agreement had been concluded between the Jordanian Phosphate Co. and the Yugoslav Yuko Metal Co. The agreement provides for a gradual increase of production of phosphate from the Rassifa mines, near Amman, up to 2,500,000 tons annually by 1963. It also provides that the Yugoslav company should start mining in the Al-Hassa region, south of Jordan, so as to produce 400,000 tons annually by 1960.

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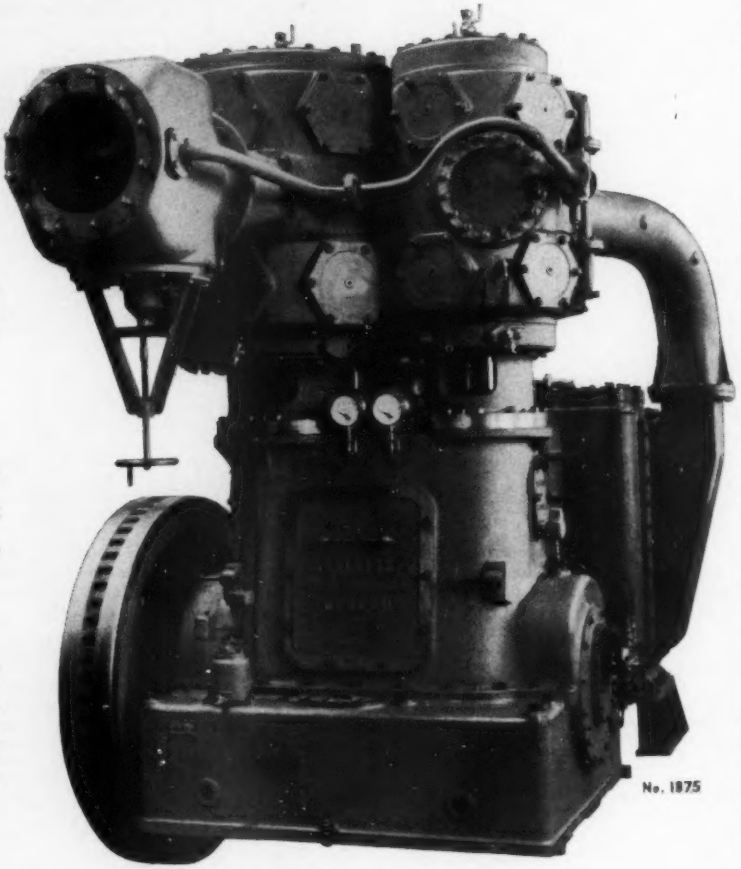

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Yugoslavia is said to have undertaken to buy 75 per cent of its phosphate requirements from Jordan. The question of transporting phosphate from Rassifa to Aqaba and Beirut ports is under consideration. Phosphate production in the Al-Hassa region would considerably ease the transport problem, as the fields are near the sea.

Jordan was reported to be granting Poland a concession for exploration and for exploitation of iron ore. The Poles would supply technicians and prospectors and would undertake to mine and market the ores if sufficiently large deposits are found.

It is believed that in addition to iron, copper and phosphate, large deposits of gold and silver exist in the Maan district of southern Jordan.

The Jordan Ministry of National Economy has lifted a ban on mineral prospecting in the area north of Akaba, where copper has been discovered.

A Jordanian financier is reported to have received the first concession for uranium, covering a 300 sq. mile area in the Akaba region. Prospecting is under way.

CYPRUS

IN spite of the emergency, and also of the falling prices of its principal products, the mining industry of Cyprus again had a record year in 1957, the quantity of mineral products exported during the year being slightly higher than in 1956 (1,197,190 tons compared with 1,168,558 tons).

As can be seen from the table, exports of copper pyrites, copper concentrates and copper cement were higher, but those of iron pyrites, asbestos and chromite declined. Exports of copper minerals totalled 369,420 tons against 293,943 tons in 1956, but the value fell to £6,192,145 from nearly £9,000,000 in the previous year.

Other mineral exports during 1957 included 41,687 tons of raw gypsum, 1,256 tons of calcined gypsum, 4,317 tons of umber, 387 tons of yellow ochre, and 785 tons of bentonite. West Germany remained the largest buyer of copper minerals, while shipments were also made to the U.S., Italy and the Netherlands. Germany was the sole buyer of copper cement.

Esperanza Copper and Sulphur Co. Ltd. has decided to operate on a major scale in water leaching the Limni semi-oxidized body, consisting of some 600,000 tons of ore, averaging 1.47 per cent copper, together with gold and silver values which, it was hoped, would be to some extent recoverable in separate operations. A recovery of some 7,000 tons of cement copper averaging 65 per cent metal was anticipated. Installation of all the requisite plant and equipment is practically completed and production of cement copper should soon be started.

Over 30,000 tons of cupreous pyrites are in stock towards the contract quantity of 50,000 tons to be delivered in 1958. The company is undertaking the production of an additional 60,000 tons of ore to yield 7,500 tons of good grade concentrates in 1958. In March, 1958, a contract for the sale of these contracts was reported to be under negotiation.

Cupreous pyrite will continue to be shipped from Esperanza's Kinousa Mine and Kinousa opencast and the company has forward contracts for 1958 and 1959. Developments in this section have proved more favourable than anticipated and output could almost be doubled if market conditions were more favourable.

MINERAL EXPORTS
(000's l.tons)

	1955	1956	1957
Iron pyrites	753.7	821.7	**762.5**
Copper pyrites	133.6	171	**226.3**
Copper concentrates	77.7	119.2	**139.1**
Copper cement	2.8	3.7	**3.9**
Asbestos.....	12.8	12.5	**11.8**
Chrome	8.5	5.8	**5.0**

No further commercial orebodies have yet been disclosed by exploration, but geophysical work and drilling will be intensified in 1958 both on the concession and on a new area of 80 sq. miles under application.

The Tharsis Sulphur and Copper Co. Ltd. continued its investigation of the old Centre Lode at Tharsis and promising results were recorded. The pyrites from the investigation gallery and cross-cuts is of good cupreous quality and high sulphur content. Present indications are that sufficient tonnage will be proved to justify the removal of overburden.

At Calañas production from the 18th floor is increasing and the company is continuing its investigation of this large orebody in length and width. At this level the orebody maintains the remarkable dimensions of the 14th floor, 16 metres above.

In his report for 1956 the Inspector of Mines for Cyprus refers to the severe effects of the emergency on operations by Cyprus Asbestos Mines Ltd. at the Amiandos mine, situated at an altitude of 4,500 ft. on the Troodos mountains, in the heart of known terrorist country. Most of the company's labour force is drawn from the mountain villages, one or more of which were often under operational curfew during the working season. The Cyprus Chrome Co. Ltd., whose mine is also situated at a high altitude in the Troodos mountains, was similarly handicapped.

TURKEY

TURKEY'S shortage of foreign exchange remained acute throughout 1957, while the mining industry continued to be hampered by import restrictions and transportation difficulties.

Chrome

Chrome production in the first 10 months of 1957 totalled 236,541 tonnes, which compares with 272,440 tonnes in all 1956. During 1957 Turkey exported chrome ore worth about £T63,000,000 to the U.S., the U.K., and Western European countries. About £T28,000,000 worth was high-grade material.

The barter of Turkish chrome ore for U.S. agricultural surpluses was finally completed in mid-1957 and involved about $10,000,000 worth of ore. Attempts to conclude this transaction had been proceeding for about a year. It was announced early in 1958 that Turkey had agreed to supply 150,000 tonnes of chrome ore to the U.S. over several months.

Turkey's Maden Kredi Bankasi (Mineral Credit Bank) has begun operations, its initial capital being £T28,000,000. Credits will be given mainly to improve export possibilities for Turkish chrome. The Bank has called into being a chrome production company under the name of Krom-Ischletmesi AO to represent the interests of chrome mine owners. The new body does not supersede the Chrome Committee.

Expansion now being carried out at the two southern Turkish ports of Mersin and Iskenderun will greatly facilitate shipments of Turkish chrome ore.

A ferro-chrome manufacturing unit is to be built in Turkey by a French group comprising Péchiney and Compadec.

Copper

The production of copper rose from 24,000 tonnes in 1953, after a contraction to 23,800 tonnes in 1955, to 27,000 tonnes in 1956, the latest year for which official particulars are available. Exports totalled 17,995 tonnes in 1956 as against 15,848 tonnes a year before.

The Ergani mine produced 14,501 tonnes of copper in the first 10 months of 1957 against 17,718 tonnes in 1956. Its ore reserves are now estimated to contain some 360,000 tonnes of metal. The Murgul mine produced 5,599 tonnes in January-October, 1957 (7,045 in 1956). New plant at Murgul is nearing completion and a large increase in output at this mine is anticipated.

It is expected that an electrolytic copper refinery with a capacity of between 4,000 and 5,000 tonnes will go into operation by the end of 1958.

The Eti-Bank's prospecting team operating near the Ergani mine has found a new deposit of copper ore believed to be extensive.

Other Minerals

Iron ore production at private mines yielded nearly 500,000 tonnes in 1957, and State mines 460,000 tonnes.

The British-built iron and steel works at Karabük, near the Zonguldak coal mines in north-western Anatolia (completed 1938) are largely fed with iron ore from magnetite mines near Divrik in central Anatolia (to the south-east of Sivas), which have reserves estimated at 15,000,000-20,000,000 tonnes, a considerable drawback being the distance of more than 600 miles between the mines and the steel works.

An important iron ore deposit (high-grade ore with 65 per cent Fe) near Edremit, a coastal place to the north of Izmir, which would be more convenient for both supplies to Karabük and exports, has become the object of a German scheme envisaging the establishment of a metallurgical centre in situ.

Karabük also obtains some iron ore from a mine near Ismit, some 60 miles from Istanbul on the Anatolian coast.

To the south of Ismit, the wolfram mine in the Ulu Dagh region near Bursa is to be jointly worked by the Eti Bank and Krupp's in accordance with an agreement concluded by the end of 1957. The entire technical equipment is to be provided by Krupps, and the annual output of tungsten metal is envisaged, initially, at 180 tonnes.

In the first half of 1957 a record coal output of 3,105,636 tonnes was achieved. In the same period production of lignite totalled 800,308 tonnes.

Improvements carried out recently in the Zonguldak coal mines have increased capacity to 16,000 tonnes a day, enabling total home requirements to be covered and providing a surplus for export.

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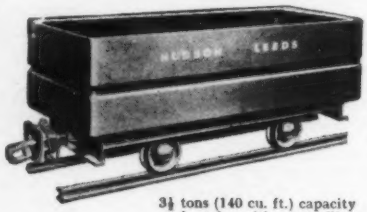
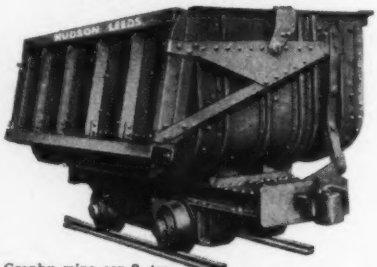
MINE CARS

COAL MINING



3½ tons (140 cu. ft.) capacity coal tub with swivelling coupling.

ORE MINING



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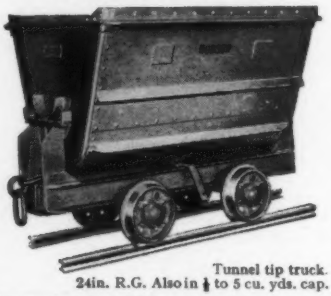

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THE SOVIET UNION *By J. Grindrod*

TWO far-reaching events, industrially, took place in the Soviet Union during 1957. In May, many of the 52 central Ministries were abolished and the country was divided into 105 economic regions controlled at the centre by a State Planning Committee with greatly increased powers. The second great change, which took place in the autumn, was the Soviet Government's decision to replace the Sixth Five Year Plan (1956-60) by a new plan running from 1959 to 1965.

Although the 11 per cent overall increase in industrial production during the first year of the sixth plan came up to the normal level, it was considered that certain branches of industry whose products were vital for growth were not coping with their tasks. For instance, the Coal Ministry failed to reach its target by 18,000,000 tons, partly because only 95 of the expected 165 new mines came into production. The Ministry of Iron and Steel was another that failed to reach its target. Failure immediately to implement the decentralization law has also been given as a reason for the planning change, as also has the need for the development of new and extremely rich deposits of coal, iron ore, oil, gas, etc. and sources of electric power, indicating the possibility of industrial capacity having outrun supplies of raw materials and power.

This emphasis in the development of sources of raw materials would seem to indicate a period of great activity and rapid growth in the mining and kindred industries.

In 1957, the Soviet Union produced 483,000,000 tons of coal which was 104 per cent of the 1956 production. Of this 88,000,000 tons (106 per cent of 1956) was coking coal. Compared with 1956, capital investment in the coal industry increased by 21 per cent and 95 large coal mines were brought into use, including over 50 new pits in the Donetz and Kuznetsk basins, which will yield 60,000,000 tons annually. It is claimed that in the near future 366 pits will be commissioned with a production capacity of 204,000,000 tons of coal annually. Within the next 15 years coal output is expected to reach 650,000,000 to 750,000,000 tons annually.

It is reported that vertical shafts are being sunk in the Lvov-Volyn (Ukraine) coalfields by powerful 70-motor, 2,500 kW machines, which can sink shafts with a diameter of 4 ft. The same machines are reported to place pig iron tubing in positions in the shafts. It is also reported that a new cleaning plant capable of separating from rock all particles of coal down to ½ mm. is being used in the Donbas.

It is claimed that the Lena Coal Basin in Yakutia (Eastern Siberia), geological mapping of which is soon to be completed, has a proved capacity of nearly 5,000,000 million tons, and might contain some two-and-a-half times as much coal as the whole world's reserves. In places, open-cast mining will be possible. Currently, the Uzhno-Yakutskoe coking coal deposits are the most accessible and, here, the veins are between 100 and 130 ft. thick. Large deposits of 50-60 per cent iron ore have also been discovered with the coking coal, and South Yakutia is expected to become an iron and steel producing district. There are also some deposits of lime, dolomites and quartzites in the region.

In the ferrous metal industry 1957 production figures were: iron ore 84,200,000 tons (108 per cent of 1956); pig iron 37,000,000 tons (104 per cent of 1956); steel 51,000,000 tons (105 per cent of 1956); rolled steel 40,200,000 tons (106 per cent of 1956). Development is to be speeded up in 1958. Surveys of iron ore deposits, especially in eastern regions, are to be intensified, mining capacities increased by some 10,000,000 tons and preparations made for further underground and open-cast mines and ore concentrating plants with a total annual capacity of 24,700,000 tons of ore to be brought into production in 1959.

Large new deposits of iron ore are reported to have been found in various parts of Siberia, in the south of the Kokchetav region of Kazakhstan, and in the area of Lake Atansor, near Kremenchug in the Ukraine. It is claimed that in about 15 years the annual pig iron output in the U.S.S.R. will be 75,000,000 to 85,000,000 tons and steel output 100,000,000 to 120,000,000 tons, involving more than treble the rate of iron ore extraction, stepping up the annual output to 250,000,000 to 300,000,000 tons. The 1958 targets have been announced as 39,100,000 tons pig iron, 53,600,000 tons steel and 41,700,000 tons rolled steel.

In the field of non-ferrous metals, the Soviet Minister of Geology has claimed that as a result of prospecting carried out in 1957, the U.S.S.R. now holds first place in the world for reserves of nickel, lead, copper and bauxite, though the mining of these deposits will doubtless present many problems in inaccessible regions. One of the richest of the newly discovered mineral bearing regions is Kazakhstan, where high quality bauxites and many kinds of non-ferrous and rare metals have been found. To date, nearly half the prospected deposits of copper, lead, zinc and tungsten in the U.S.S.R. and more than one-fifth of the molybdenum reserves are concentrated in this area. It is claimed that the reserves of chrome and vanadium here are the largest in the world. At Djezkazgarsk in the centre of the Kazakhstan copper mining area, what is claimed to be the world's largest copper smelting and refining complex is being built.

Other areas in which rich deposits of non-ferrous metals have been found include the Ukraine (bauxite, mercury, tin, zinc), Siberia (copper-nickel sulphite ore, also containing cobalt and platinum; copper, lead, wolfram, zinc, tin boron, gold, molybdenum, bauxite, diamonds), Transcaucasus (copper, gold, silver, zinc, cobalt, molybdenum). Lithium and boron have been found in the Kola Peninsula and Kazakhstan respectively. Official reports say that bluish-grey nepheline extracted from the apatite deposits in the Kola Peninsula is being used as the main raw material for aluminium instead of bauxite.

Concern has recently been expressed at the use of antiquated equipment in non-ferrous metal mines and at the wasteful treatment methods used, especially in copper smelters and enrichment plants, where each year considerable quantities of zinc, lead, cadmium, selenium and tellurium are lost in processing.

Uranium production is centred in five main areas, of which the most important is the Ferghana region (Central Asia), estimated to produce over 50 per cent of current Soviet output. Extensive development is, however, being carried out in other areas. In all, the Soviet bloc is thought to produce more than 6,000 tons of uranium annually.

Under the new Sixth Five Year Plan increases of 60 per cent in refined copper production, 42 per cent for lead, 77 per cent for zinc, 64 per cent for nickel, 100 per cent for molybdenum, 57 per cent for tungsten concentrates, 110 per cent for magnesium and aluminium have recently been reported.

Further discoveries of diamonds in Yakutia, Siberia, have been reported and rapid progress is claimed towards production of the 600,000 ct. of industrials per year required by Soviet industry.

POLAND *By Our Own Correspondent*

DETAILS of Poland's Five-Year Plan as it will affect the coal industry have been released by the Minister of Mining and the Power Industry. One of the basic tasks is the achievement of a hard-coal output of 105,000,000 tonnes in 1960. In the past big industrial works, towns and settlements in the coal basin were built on non-exploited seams of coal. The amount of coal contained in these seams under towns in the Silesian basin is estimated to exceed 3,000,000,000 tonnes. Under the Five-Year Plan, the proportion of coal extracted from these seams in Silesia will reach 30 per cent of the total.

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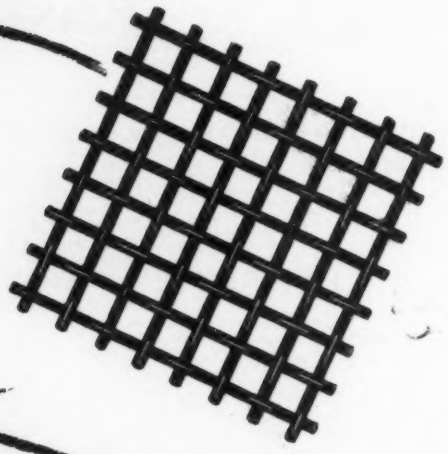

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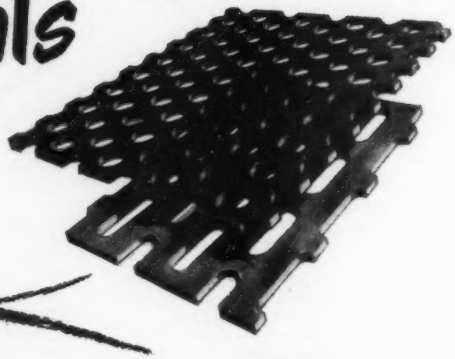

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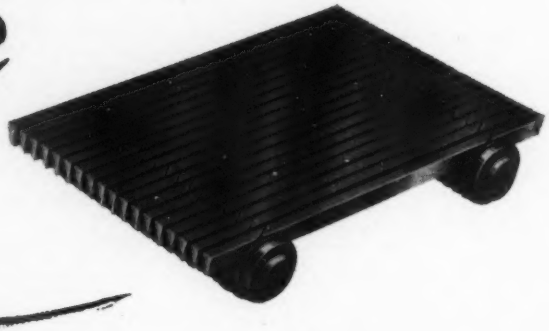

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The Five-Year Plan provides for sinking shafts at only five collieries. Much attention is being given to shallow- and medium-depth mines in order to achieve the most rapid results. Fifteen collieries have already been set in operation during the current Five-Year Plan and 37 more collieries of this type will be handed over by 1960. The planned capacity of all shallow mines will then amount to 15,500 tons of coal per 24 hours.

Brown coal output is to be increased to 11,000,000 tonnes per year, which will be almost double the production in 1955. Poland and East Germany are co-operating on the development of a new brown coal basin at Turoszow in Lower Silesia, where deposits are estimated at some 1,000,000,000 tonnes. It is expected that in 1965 two open-cast collieries will yield over 25,000,000 tonnes of brown coal. From 1960 onwards, Poland will supply East Germany with some 6,000,000 tonnes of brown coal annually.

In 1957 the coal mining industry exceeded its scheduled target by 1,000,000 tonnes, the year's production being in the region of 94,000,000 tonnes.

In the Debiensky colliery, Katowice voivodship, assembly work was completed on hydromechanical installations for the vertical transport of coal to the surface. Water at 70 atmospheres pressure will convey coal from a depth of 300 metres.

Research has revealed that germanium is present in some of the coal seams in Poland. Already a few kgms. of this metal have been obtained on a semi-industrial scale.

The iron ore industry plans to raise domestic output, which is expected to increase by an average of 1.5 per cent to 2,000,000 tonnes in the next five-year plans.

On December 4, 1957, Poland's first sulphur mine was commissioned in Piaseczno near Tarnoorzeg, Rzezow voivodship. The mine should yield 50,000 tonnes of ore in 1958 and about 250,000 tonnes in 1960. Czechoslovakia is co-operating in the exploitation of Polish sulphur deposits, which are expected to yield about 100,000 tons of pure sulphur by 1961.

Construction has started of a large alumina plant at Gorka, Cracow voivodship, which is scheduled to go into production in 1959, using locally occurring materials. As a result of the expansion of the Skavina aluminium plant, the country's requirements of alumina have risen sharply, imports for 1957 being estimated at 49,000 tonnes.

Poland's imports of zinc concentrate in 1957 were in the region of 140,000 tonnes. Output of zinc metal in 1956 amounted to 150,000 tons. The possibility of reduced dependence on imported concentrates is indicated by the discovery of rich zinc and lead ore deposits in the Bledow and Starczynow desert, Katowice voivodship, at a depth of 45-65 ft. At Starczynow the seams are reported to be several yards thick. A new zinc mine is to be established near Trzebinia.

Intensive work on the exploitation of copper ores is being carried out in order to limit imports. After expansion has been completed the Konrad mine, Wroclaw voivodship, will produce more than 1,000,000 tonnes of copper ore yearly. The Nowy Kosoiol copper mine in the same area is also being expanded, an output of 400,000 tonnes annually being envisaged by 1960. Shaft-sinking is being carried out at a new mine near Boleslawiec, Wroclaw voivodship, which will start producing in 1960.

Rich deposits of copper-bearing ore have been discovered in the region of Lubin and Sieroszowice, Wroclaw voivodship. The deposits cover an area 14 miles long and four miles wide. The layers of copper-bearing ore are described as about 90 in. thick and occur at some 2,000 ft.

Large-scale prospecting for mineral wealth, including radioactive minerals, is being conducted by 25 teams throughout the country.

CZECHOSLOVAKIA

TENDING to follow the five-year pattern of development normally associated with Communist countries since the war, industry in Czechoslovakia has been scheduled to conform initially to the First Five Year Plan, which covered 1949-1953 and was subsequently extended to 1955, and, later, to the Second Five Year Plan, covering the period 1956-1960. Under the First Five Year Plan emphasis was placed on heavy industry to such an extent that shortages occurred in consumer goods. Under the Second Five Year Plan emphasis has been switched to a considerable extent to consumer goods.

It is against this background that Czechoslovakia's considerable mineral resources are being developed. These include large anthracite and brown coal-fields, two major iron ore deposits, deposits of uranium, pitchblende and magnesite and a small oilfield.

In 1957, steel output was 5,200,000 tonnes and, under the 1957 yearly plan, was to have increased by 6 per cent over the previous year's figure. The 1958 target is rather more than 5,600,000 tonnes or 8.1 per cent higher than for 1957.

Pig iron production in 1957 was 3,600,000 tonnes compared with 1,950,000 tonnes in 1950 and 2,950,000 tonnes in 1955. Pig iron output was scheduled to increase by 9.7 per cent in 1957 and the corresponding increase set for 1958 is 5.8 per cent.

In the coal mining industry, the production of anthracite in 1957 was 24,200,000 tonnes compared with 18,159,000 tonnes in 1950 and 21,800,000 tonnes in 1955. The scheduled 1957 increase in output was 4.7 per cent and the 1958 target is set 3.6 per cent higher than that for 1957. Brown coal was mined to the extent of 49,000,000 tons in 1957, compared with 27,072,000 tons in 1950 and 40,100,000 tons in 1955. The scheduled target rise for brown coal output for 1957 was 7.4 per cent compared with a target rise of 6.1 per cent for 1958.

In order to conserve the more valuable hard coal deposits steps are being taken to substitute the use of brown coal or lignite for hard coal for use in industry wherever possible. Construction began in the autumn of 1957 on a gas works near the river Elbe near the East German frontier, said to be among the largest of its kind in Europe, for processing very low grade lignite from nearby mines. It is claimed that the new plant will produce 475,000,000 cu. metres of gas annually, as well as such by-products as nearly 100,000 tonnes of tar, crude oil and other chemicals. The plant is due for completion in 1961.

No information is available about output at the Joachimstal pitchblende deposits but rich new uranium deposits are reported to have been found by geological survey crews in the abandoned Katharinenberg and other silver mines in the Bohemian Forest region near Pribram. If these are confirmed they will supplement production at the already existing uranium ore field at Krusne-Hory. The first Czech reactor was also recently reported to have been put into production to yield 2,000 kW.

Already rich in magnesite deposits, which are estimated to contain 50,000,000 tonnes, Czechoslovakia is also said to have discovered a new 100,000,000 tonne high grade deposit near the Russo-Czech border and it is believed that further deposits in the same area may be revealed. It is reported that plans are in hand for the exploitation of this new discovery, and a vast expansion of the magnesite industry generally is envisaged under the current Five Year Plan. Following the establishment of a large brickworks in Lubenik, one of the prinpal magnesite areas, in 1956, other plants were being planned for Podrecany and Tahanovce.

Rich finds of titanium minerals during large-scale geological work were reported.

EAST GERMANY

EAST GERMANY is the most highly industralized country in the Soviet orbit. It has efficient steel works, rich soft-coal mines, and uranium deposits which supply one-third of Russia's needs. Under the aegis of Moscow mining and industrial production is steadily growing. Steel production at 2,500,000 tonnes is twice what it was before the war. Coal, aluminium, zinc and nickel output is rising, but the emphasis on expansion has produced a chronic power shortage, which shuts down plants for hours on end. Planning has apparently been characterized by clumsiness and lack of co-operation.

In the six-months period ending June 30, 1957, lignite production increased to 106,800,000 tonnes from 101,400,000 tonnes in the corresponding period of 1956, briquette production to 26,500,000 (25,300,000) and crude steel to 1,420,000 (1,340,000).

Under the plans announced, production is to reach the following targets in 1960: coal 2,950,000 tonnes, lignite 248,600,000 tonnes, briquettes 57,600,000 tonnes, and energy 41,500 kWh. In 1956, the national economy disposed of solid fuel equivalent to 70,000,000 tonnes of coal. By 1960, primary energy equivalent to 85,000,000 tonnes of coal is to be available.

In 1956 East Germany produced 25,000 l.tons of copper ore and 30,000 tons of copper metal, 6,000 tons of lead ore and 30,000 tons of lead metal, 660 tons of tin ore, and an estimated 2,000,000 tons of potash (K_2O content).

A plant for the extraction of scarce metals such as germanium and indium is being set up in Muldenhuetten, near Freiburg. Raw materials will come from nearby mining waste dumps, as well as from the deposits in the flues of the VEB Feinzink Freiburg. Total costs will be about 10,000,000 East German marks. The plant is scheduled for completion within the period of the current Five-Year Plan.

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The East German uranium mines were developed by the Russians after the war, using forced labour. They are now worked by a State-owned company called Bismuth A.G., in which the U.S.S.R. and the East German Government both hold shares. Output remains a closely guarded secret, but it has been revealed that in 1957 uranium accounted for one quarter of East Germany's exports to Russia, the price paid being 800,000,000 roubles (roughly £20,000,000).

HUNGARY *By Lawrence Kirwan*

EFFORTS to get coal mining back on to a normal footing after the disruption of the 1956 counter-revolution in Hungary were in 1957 on the whole successful. Though production did not quite achieve the 1956 pre-October level, it was a great deal better than economists had expected. Output totalled 20,900,000 tons, which was about 800,000 tons in excess of target.

Hungary's best ever production was 22,315,000 tons, in 1955—small by international standards but a big advance on the pre-war (1938) production of 9,400,000 tons. The disorders of 1956 cut output in that year to 17,364,000 tons.

The improvement continues, for in January this year (1958) it was announced that the daily average of 79,530 tons now exceeded the September 1956 level. It remains to be seen whether the 1958 target of 23,600,000 tons will be reached.

The mines labour force has always been Hungary's biggest problem, so the year 1957 was marked by considerable efforts to make the miners more comfortable, both economically and socially. By January 1958, the number of workers employed in coal-mining had risen to 99,265 (January 1957: 90,000).

Wage advances of 33 per cent made miners the best paid workers in Hungary.

There has been a good deal of development of open-cast workings. In August it was announced that new deposits of "many millions of tons" of good quality lignite had been opened at Visiona, at the foot of the Matra Mountains. At the beginning of 1958 open-cast workings began at Bantapuszta, eastern Hungary, on a seam which should yield 330,000 tons this year.

In the south, where most of the country's limited hard coal is found, the Pecs Trust stated that it was to make very large investments over the next five years developing the Hosszhatany region, where deposits estimated at 70,000,000 tons had been established by geological surveys.

Mechanization is making slow progress, partly due to problems of finding suitable support apparatus for the unstable soil and rock conditions found in Hungarian mining. Best results in mechanized cutting so far have been obtained by the drift-driving F-4 in the Matra region of north Hungary. Experiments are now being carried out with the prototype of an improved machine, the F-5.

Outstanding results are stated to have been obtained with the Hidasi type light loading machine, which in an eight hour shift can move 31.4 tons of coal. Fifty of these machines are now being made for introduction in the pits in the second half of 1958.

At the beginning of 1958 the Borsod Trust in north-east Hungary announced it was installing 500 electric drilling machines, which would give at least one machine to every face there and improve output by 400 tons a day.

Uranium and Bauxite

Little news has come out of Hungary about the development of uranium mining, since the reports last year that Russian experts had now left Hungarian engineers to run the workings and that new machines had arrived from Russia. The only clue to progress is the announcement in January this year (1958) by Professor Lajos Janossy, vice-president of the Atomic Energy Committee, that uranium mining "has now started off at a rapid pace."

Bauxite production in 1957 was well below figures for recent years other than the disastrous 1956. Output was 917,260 tons, compared to 1,260,000 in 1954, 1,236,000 in 1955, and 868,000 in 1956. It was still, however, considerably better than in the last pre-war year (1938: 540,000 tons).

New deposits of bauxite were found during the year at Varoslod and Sumeg, western Hungary.

AUSTRIA

ALTHOUGH, according to official statistics, overall mining output figures for 1957 were up on those for 1956, Austria's non-ferrous mining enterprises have been sharply affected by the declines in world metal prices and a number of expansion projects have been curtailed.

At 1,172,600 tonnes, the 1957 output of crude magnesite maintained the steady increase of recent years, which reached 1,078,397 tonnes in 1956. The gain for the year represented 8.1 per cent compared with 10 per cent in the previous year. In 1950, the output was only 607,112 tonnes. Production of sintered magnesite in 1957 was 423,400 tonnes and that of caustic magnesite 105,900 tonnes.

Copper ore production in 1957 increased 7.8 per cent from 152,590 tonnes in 1956 to 165,200 tonnes, but as a result of the heavy price decline producers were encountering serious difficulties early in 1958, especially since it appears that no measures of modernization or process improvement would be effective in making up for the cut.

The output of lead-zinc ore recovered from the decline which set in during the autumn of 1956 and amounted to 182,800 tonnes for the whole of 1957, an increase of 12.2 per cent over the 1956 figure of 162,930 tonnes.

At 22,300 tonnes, the production of bauxite in 1957 was 1 per cent higher than in 1956, when output stood at 22,093 tonnes. Over half the bauxite output is used by the iron and steel works and by cement and abrasive producers, the rest being exported to W. Germany for processing into alumina.

Other 1957 production figures include quartzite 82,300 tonnes, antimony ore 11,000 tonnes, graphite 18,900 tonnes, crude kaolin 302,200 tonnes.

Iron ore production reached 3,500,000 tonnes in 1957, an increase of 7.3 per cent over the 1956 figure of 3,257,887 tonnes. Output at Alpine Montageselleschaft reached an all-time peak of over 3,000,000 tonnes.

Austria's coal production amounted to 7,027,684 tonnes in 1957, 131,999 tonnes higher than in 1956.

Built during the war and having a capacity of about 55,000 tonnes per annum, the Ranshofen (upper Austria) aluminium plant cut back its winter production more than usual this year because of a softening of the international aluminium market. Austrian aluminium exports in the first three-quarters of 1957 dropped by 5,400 tons compared with the same period in 1956. Output in 1957 is recorded as 83,800 tonnes (65,447 tonnes in 1956).

With a view to aiding any non-ferrous metal mining enterprise which is in difficulties, a draft "Mining Development Law" is in preparation by which contributions to a State-aid fund would be levied from other mines, processors of minerals and importers of non-ferrous metals. This is meeting opposition from industrial circles. Imports of lead and zinc are also being made subject to import licensing.

According to a recent geological report uranium mineralization has been found at Mallnitz (Salzburg) Zillingdorf (Burgenland), Nuefeld (Lower Austria) and Trimmelkan (Upper Austria). Further exploration is being carried out along the Danube Valley.

GREECE

MINING in Greece continued to expand in 1957 at the same rate as in 1956, the year when, for the first time, the output of the Greek mines as a whole exceeded the pre-war level. Taking 1939 as 100, the index of ore mining rose from 13 in 1947 to 86 in 1955 and 120 in 1956. In 1957, it stood at 150 in January and reached 180 in August. The exploitation of the country's geological riches, although far from comprehensive, has become one of the mainstays of Greek exports.

The most important development in the mining industry during the year was the official start on July 26 (the actual start was several months earlier) of the extensive work for the development of the Ptolemais lignite deposits in north-western Greece. Extending over some 60 sq. miles, these deposits are estimated to contain approximately 400,000,000 tonnes of lignite and rank first among the country's various lignite occurrences. The smaller deposits to the north of Ptolemais are believed to total 200,000,000 tonnes of lignite. Extraction at Ptolemais will start by the middle of 1959, and the initial annual production is envisaged at 2,000,000 tonnes. Half of this output will be absorbed by a 70,000 kW power station which the Electric Power Board is erecting on the site, while 200,000 tonnes will fire a 10,000 kW power station under construction

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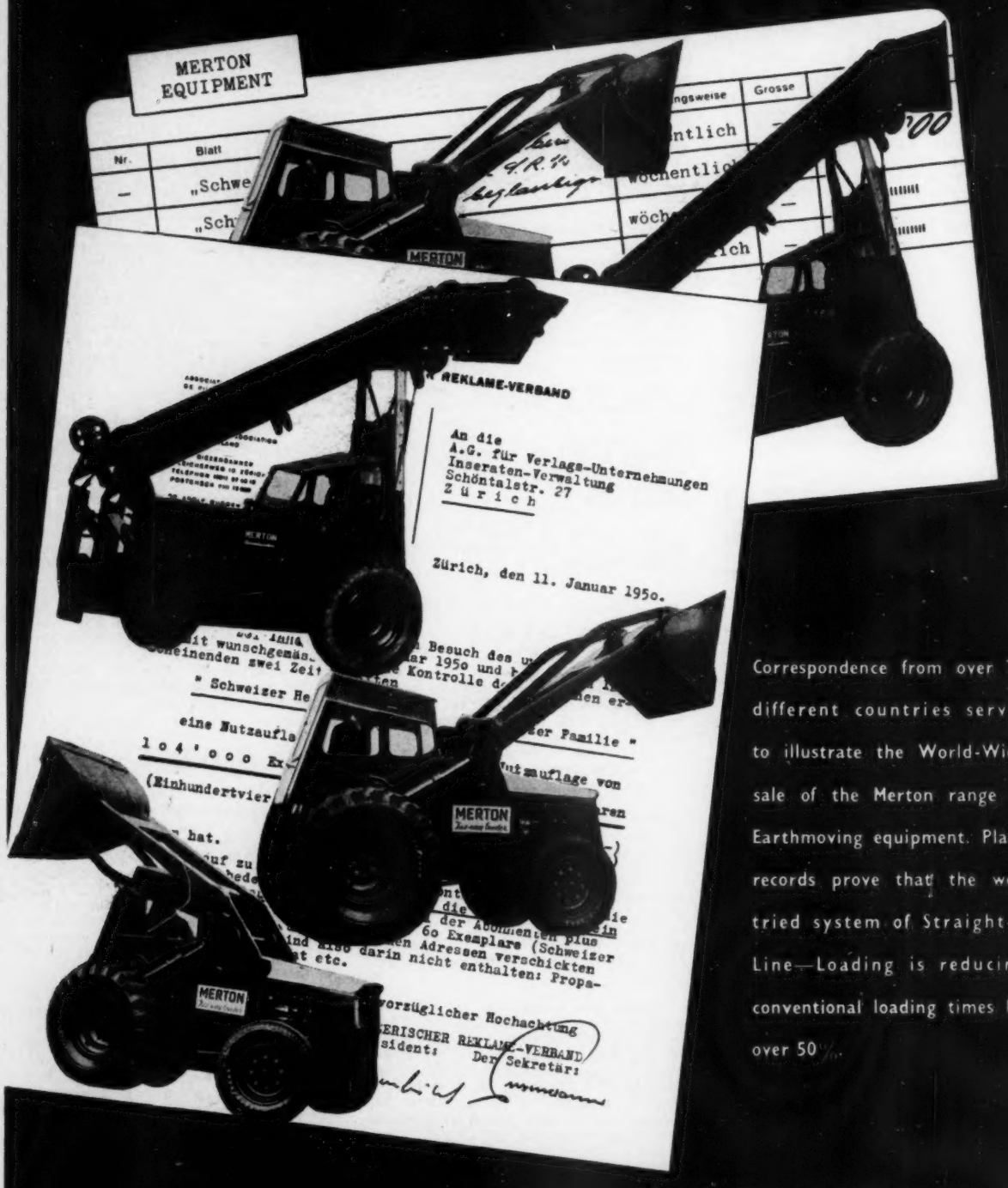

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by the Ptolemais Lignite Mining and Industrial Co., the concessionnaire of the scheme. Power supplied by this second station will be available to the mines and to the industrial works envisaged by the scheme.

Among the first of the industries to be established at Ptolemais will be a briquette works which is to convert 400,000 tonnes of lignite p.a. into 200,000 tonnes of briquettes; a further 300,000 tonnes p.a. will be required for the production of special fuel (80,000 tonnes) needed for the Larymna nickel smelting plant.

The final output of the lignite mines is envisaged at 5,000,000 tonnes p.a. with corresponding increases in the allocations to existing plants as well as for other consumers. The cost for the completion of the whole scheme by 1959 is envisaged at $20,900,000.

The second key scheme in the Greek industrialization plan is the mineral oil refinery of Aspropyrgos, on the coast some 25 miles west of Athens. This State-owned refinery, built by the West German subsidiary of the U.S. Hydrocarbon Research Inc. in co-operation with West German steel interests was completed in November, 1957, with a throughput capacity of 1,340,000 tonnes p.a.

Efforts to find mineral oil in Greece have not so far been successful, but prospects continue to be described as promising.

ORE EXPORTS
(tonnes)

Year ended June 30	1956	1957
Iron ore	270,315	**498,474**
Lead ore	7,044	**9,361**
Zinc ore	16,748	**22,604**
Manganese ore	18,436	**13,107**
Chrome ore	37,537	**48,653**
Magnesite	14,529	**14,632**
Emery	6,118	**4,221**
Iron pyrites	129,863	**233,279**
Bauxite	591,443	**772,867**
Barytes	11,356	**50,545**
Total	1,613,389	**1,667,743**

The problem of setting up an aluminium industry based on the country's wealth of bauxite is receiving the Government's attention. A commission was appointed some time ago to study the possibility of producing and exporting aluminium to replace the much less profitable exports of bauxite, of which almost the sole buyer has been Western Germany, although increasing quantities went to the Soviet Union in recent months. Negotiations are in progress with West German and American interests.

The modernization of the magnesite mines at Vavdos, Chalcicide Peninsula, northern Greece, has been delayed owing to a disagreement between the State and the new concessionnaire (from July, 1957), namely the Austro-American Magnesite Co., and its operating company "Magnomine." A settlement was reached before the end of 1957. It is believed that output will exceed the total of 20,000 tonnes reached in 1957, most of which was exported.

The American Kennecott Copper Corporation is reported to be completing the modernization of its asbestos mine near Kozani (to the south of Ptolemais).

In connection with the Government scheme for setting up a steel industry in Greece, plans were submitted before the end of 1957 by the new shipbuilding concern (Niarchos interests) in collaboration with the American Copper's concern and with Krupp's, for a works at Skaramangà (to the west of Athens). Annual output of steel and by-products is envisaged at 300,000 tonnes. Iron ore would be supplied from the deposits on Thasos island in northern Greece, in which Krupp's are already interested, and from others near Longanicon (Peloponnes) taken over by Belgian interests (Auxiliaire Minière Chimique S.A.) last summer.

Recent rumours that uranium ore had been located in Greece were followed (in March) by a statement from Arliotis, the Minister of Co-ordination, that the discovery of uranium ore deposits in Greece was being studied.

YUGOSLAVIA *By E. A. Bell*

INDUSTRIAL production in Yugoslavia in 1957 rose by 17 per cent, as compared with 1956, but the expansion showed considerable variations in different sections of the economy. In the field of mining, the output of coal rose by only 4 per cent, and that of iron ore and non-ferrous ores by 5 per cent. The processing of non-ferrous ores expanded by 19½ per cent. The output of iron and steel was 25 per cent higher, while crude oil production rose by 29 per cent.

Coal

The output of coal, in all forms, rose from 17,101,000 tonnes in 1956 to 18,007,000 tonnes, but the increase was not evenly distributed. Hard coal retrogressed from 1,232,000 tonnes in 1956 to 1,227,000 tonnes, brown coal rose only from 8,442,000 tonnes to 8,525,000 tonnes, whereas lignite increased from 7,427,000 tonnes to 8,255,000 tonnes in 1957, a gain of slightly over 11 per cent.

The bulk of the coal output originated once again in Bosnia-Hercegovina, which produced 6,780,000 tonnes—a gain of about 1½ per cent. In Serbia the output of coal rose by 7½ per cent from 4,061,000 tonnes to 4,368,000 tonnes, largely as a result of the development of the brown coal mines in the Kolubara region, to the south of Belgrade. In Croatia the coal mined rose from 2,487,000 tons by 5 per cent to 2,621,000 tons, while Montenegro, the smallest of the six federal republics, produced 137,000 tonnes. On the other hand, there was a contraction in Macedonia from 12,800,000 tonnes to 10,500,000 tonnes.

Iron and Steel

The output of iron ore, mainly from the two main deposits near Vares and in the Ljubija region (situated in Bosnia to the north of Sarajevo and in western Bosnia respectively) rose by less than 10 per cent from 1,724,967 tonnes in 1956 to 1,876,116 tonnes. The production of pig iron in 1957, at 714,000 tonnes, was twice as large as in 1954 (356,000 tonnes) and exceeded the 1956 level by 13 per cent. A record expansion was also achieved in the output of steel ingot which rose from 887,000 tonnes in 1956 to 1,049,000 tonnes, an increase of about 18 per cent.

The production of steel has in fact risen by more than 100 per cent in the past five years (1953: 515,000 tonnes). This is mainly the result of the development of the huge iron and steel works at Zenica, to the north of Sarajevo, which has an annual pig iron capacity of 850,000 tonnes. In addition, other iron and steel works, such as Jesenice, in western Slovenia, Sisak in central Croatia and Smederevo to the east of Belgrade, to mention but a few, have been expanded.

Adding to the country's immense deposits of iron ore, a discovery made in eastern Macedonia in November, 1957, revealed the existence of a deposit of magnetite ore estimated to total 10,000,000 tonnes, the iron content averaging 28 per cent. These reserves exceed all the country's other magnetite deposits together. Exploitation of the site, already in hand, will eliminate the necessity of importing magnetite ore, which has so far averaged 150,000 tonnes annually requiring foreign exchange to the tune of $4,000,000 p.a.

Oil and Natural Gas

Particular importance is being attached to the production of mineral oil and methane gas, and extensive prospecting is in progress in all regions where the geological formation points to the likelihood of the existence of hydrocarbons. Particular attention is being paid in this connection to certain areas in Croatia, the republic which so far has been Yugoslavia's main producer of crude oil. The output of crude oil rose to 395,560 tonnes in 1957, a gain of 34 per cent, but is far from sufficient to cover the country's needs.

Lack of adequate plant and piping material led to a reduction of the output of methane, also mainly concentrated in Croatia, from 68,649,000 cu. metres in 1956 to 41,525,000 cu. metres (1 cu. metre = 35.713 cu. ft.).

Copper

The development of the huge copper ore basin near Majdanpak, some 112 miles to the east of Belgrade and a few miles to the north of the old copper mining centre of Bor, is in full swing at present. The reserves have been calculated at some 160,000,000 tonnes (average metal content 0.85 per cent) and the annual output is being envisaged at 3,600,000 tonnes of ore. A large-scale flotation plant to handle this total is being

MINERAL AND METAL OUTPUT
(tonnes unless otherwise stated)

	1956	1957
Coal	17,101,000	**18,007,000**
Crude oil	293,679	**395,560**
Methane (cu. m.)	68,649,000	**41,525,000**
Iron ore	1,724,967	**1,876,116**
Copper ore	1,740,855	**1,953,134**
Lead-zinc ore	1,726,461	**1,763,937**
Bauxite	881,418	**888,240**
Magnesite, raw	194,374	**212,266**
Manganese ore	11,573	**10,234**
Chrome ore	118,762	**120,266**
Antimony ore	83,056	**85,547**
Pyrite concentrates	255,947	**312,600**
Aluminium, ingot	14,662	**18,134**
Antimony regulus	1,603	**1,769**
Copper, blister	29,384	**33,735**
Copper, electrolytic	25,088	**30,128**
Refined lead	75,759	**78,504**
Zinc raw and zinc powder	19,858	**29,459**
Mercury	456	**425**
Bismuth	111.1	**99.7**
*Silver, kg.	85,846	**80,550**

* 1 kg. = 2.2 lb.

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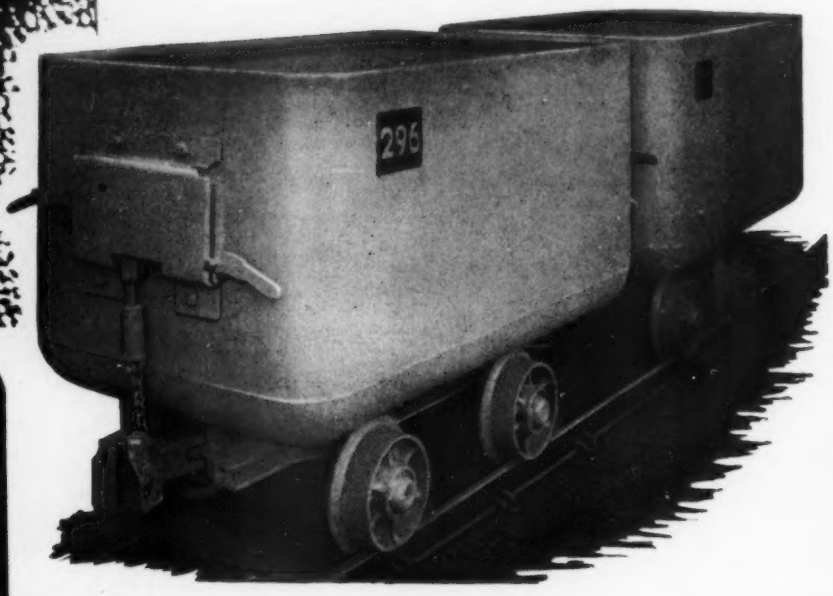

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erected on the site, the designed capacity being 120,000 tonnes of concentrate and 25,000 tonnes of copper metal respectively. An annual average of 5,500 lb. of gold and 40 tonnes of silver is envisaged as by-products.

This new source of copper added to the production of the old mine at Bor (now being modernized) will enable Yugoslavia's production of copper metal to be doubled from the totals recorded in 1957 (33,735 tonnes of blister copper and 30,128 tonnes of electrolytic copper,.

Other Non-Ferrous Metals

While the output of bauxite did not increase appreciably between 1956 and 1957 (881,418 tonnes and 888,240 tonnes respectively) the production of aluminium (ingot) rose by some 25 per cent in the same period from 14,662 tonnes to 18,134 tonnes, due to the added capacity of the works at Kidricevo (Slovenia) and Razine near Sibenik, on the coast of northern Dalmatia. The problem of Soviet collaboration for the development of the extensive bauxite deposits in Montenegro including the erection of a large aluminium works (annual capacity 50,000 tonnes of metal) has not been settled yet. Eastern Germany, too, would participate in the scheme which, as originally scheduled, would have to be taken in hand in 1959. Aluminium production should start by 1961.

Lead and lead ore continue to be important exports, the largest buyers being (in decreasing order), the U.S.A., the U.K., Austria, the Netherlands, Switzerland, Western Germany, Italy, Egypt, the Soviet Union and Poland. The production of lead-zinc ore rose slightly between 1956 and 1957, but output of lead metal expanded by about 5 per cent to 78,504 tonnes.

A large deposit of lead-zinc ore, aggregating 8,000,000 tonnes, was discovered in southern Serbia near Kosovo Polje early in March, 1958. The annual capacity of the metallurgical centre to be erected near Pristina, about four miles to the north of Kosovo Polje is envisaged as covering the treatment of 150,000 tonnes of lead ore for the production of 8,500 tonnes of lead concentrate, 1,600 tonnes of zinc concentrate, 32,000 tonnes of pyrite concentrate and 15,000 lb. of silver.

BULGARIA

A REPORT issued by the Central Statistical Office here contains the following statistics (in tonnes):

	Output in 1957	*Percentage Increase on* 1956
Copper ore.....	562,000	20
Lead-zinc ore.....	1,950,000	17
Lead	19,830	217
Zinc.....	7,513	20

South-eastern Bulgaria, where additional geological riches were discovered in recent years, has become the country's most important mining region with Kardzhali as its centre. This town is situated in the Arda Valley, by railway some 60 miles from Rakovski where the line bifurcates from the Sofia-Istanbul main line.

Lead and zinc mines had been worked in this valley for many decades, as well as further south in the Rhodope Mountains. Discoveries made in 1955 and 1956 revealed the existence in this region of lead and zinc ore deposits claimed to be the largest in Europe, interspersed with deposits of manganese, antimony, silver, pyrites, copper, etc. Lead and zinc smelting has been greatly developed but the principal activity is the preparation of concentrates mainly for export.

Coal and iron ore have also been located in this region and have become the basis of an iron and steel works at Dimitrovgrad, now Bulgaria's most important heavy industrial centre, some 48 miles to the east of Plovdiv. The first steel produced at Dimitrovgrad dates from 1953. Originally, the works had to be supplied from the iron ore mines near Elasnica, on the southern slopes of the Balkan Mountains and from brown coal mines near Pernik, some 18 miles to the south-west of Sofia.

Pernik still remains Bulgaria's leading brown coal centre but is no longer the only one in the country. Near Dimitrovgrad an immense lignite deposit, claimed to comprise 3,000 million tonnes, is being developed and the first mine is to start activities in 1958. Annual output is estimated at 10,300,000 tonnes, equivalent to almost 140 per cent of the country's total output of lignite in 1956.

Iron ore and lignite have been added to the country's exports.

An important iron ore deposit has been discovered near Sofia, while near Kazanlik in the Balkan Mountains Soviet experts are reported to be developing a uranium deposit.

Production of crude oil rose by 65 per cent from 150,000 tonnes in 1955 to 247,000 tonnes in 1956. In September, 1957, it was officially stated that home-produced oil would total 280,000 tonnes in 1957.

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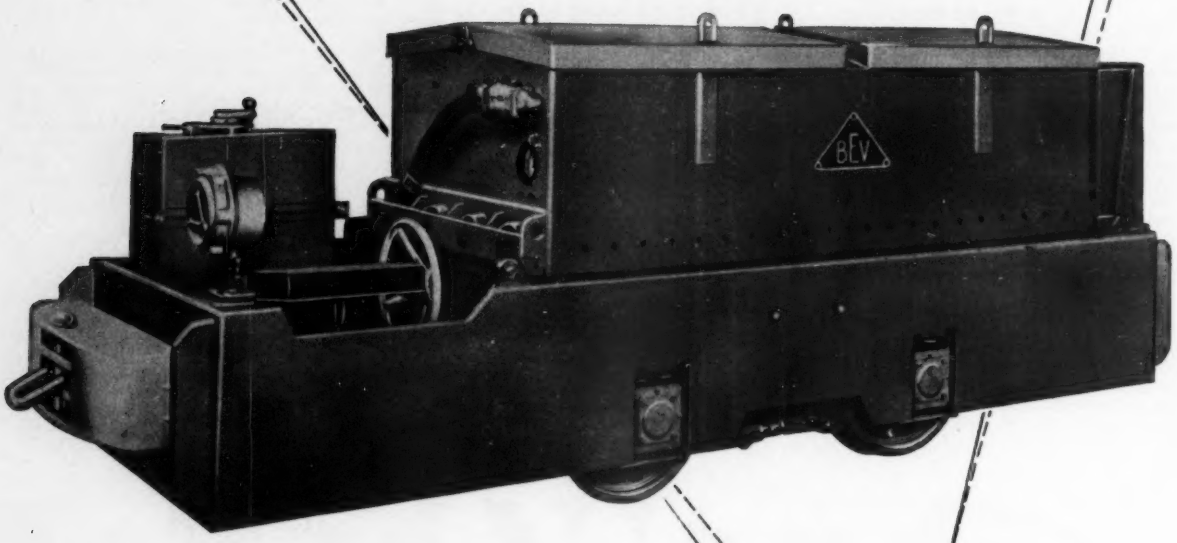

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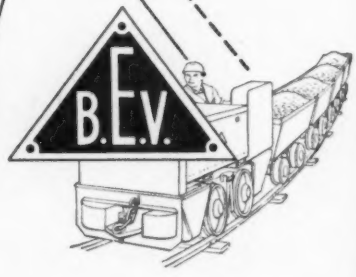

WR.19

Western Europe

ITALY • FRANCE • WESTERN GERMANY • PORTUGAL • SPAIN

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ITALY *By E. A. Bell*

MINING and metallurgical activities, in recent years prominent in Italy's general economic picture, expanded at a slower rate in 1957 than in the preceding years, and have begun showing some indications of recession since October.

The general economic index (100=1953) rose to 138 from 128 in 1956. In this increase mining played the leading part, its indices being 157 for 1957 and 139 for 1956, an expansion of 13 per cent. Though heading the list, this increase is markedly down in comparison with the 30 per cent expansion recorded for 1956.

Crude Oil

The production of crude oil continued to show the spectacular expansion which began in 1954, the index for 1957 being 275 as as against 217 for 1956, an increase of no less than 26.7 per cent. This progress has been due solely to intensified extraction in Sicily, almost entirely from the oilfields near Ragusa (south-eastern Sicily) worked by Gulf Italia, the Italian subsidiary of the U.S. Gulf Oil Corporation. Sicily's autonomous Government in Palermo has had the wisdom to formulate its mining laws, and particularly its oil mining regulations (1950), on a liberal basis favouring private (foreign included) initiative. This attitude is in striking contrast to the restrictive policy laid down in the mining laws—particularly the oil law of 1957—emanating from Rome and covering the Italian mainland only, where state-controlled concerns enjoy the upper hand.

Based on the experience recorded in Sicily in recent years the general belief is that Sicilian crude will cover more than half of Italy's entire demand for crude oil in about two or three years from now. By the end of 1957, there were 117 test wells drilled or being drilled all over Sicily and 79 had been found to show positive results.

Nuclear Collaboration

Outstanding in the field of atomic activities is the collaboration between Great Britain and Italy based on two agreements. The first one in November, 1957, was concluded between the United Kingdom Nuclear Power Plant Co. and the Agip-Nucleare, the nuclear subsidiary of the Agip oil concern, the latter forming the core of the E.N.I. Corporation. The second agreement dating from December 29, 1957, was between the two Governments, and rendered the first agreement operative. The agreements provide for British assistance for the supply to Italy of research and power reactors, the supply of uranium fuel to Italy by the U.K. Atomic Energy Authority, the exchange of atomic information, and for British aid and supplies in connection with the building of a 200 mW nuclear power station. Since the Senate failed to ratify the convention and, pending the general election in May, has been dissolved, the ratification is likely to be postponed till next autumn and the beginning of the collaboration scheme will be correspondingly delayed. The duration of the pact is for 10 years, while a similar collaboration agreement concluded in July, 1957, between Italy and the United States covers 20 years.

No further progress has been made in 1957 in respect of uranium ore discoveries in north-western Italy (Piedmont), of which there was so much ado in 1956. Hopes are now concentrating on central Sardinia where, in an area of 4,632 sq. miles. Somiren, an associate of Agip, started prospecting for uranium ore some time ago.

Coal

Sardinia has been attracting increased attention in recent years, due to the policy of the island's autonomous Government at Cagliari. In 1957, that Government, jointly with the West German oil and potash concern Wintershall-Gesellschaft, formed a company known as Società per azioni Idrocarburi Sardegna (Sardinian Hydrocarbon Joint Stock Co.), known as S.A.Y.S., in which the German company owns a majority participation of 70 per cent. The objectives of the company are to discover and exploit oil and metal ore deposits in an area (3,475 sq. miles) to the west of a line between the mouth of the Coghinas River (on the northern coast) and the Gulf of Cagliari in the south. The company's field of operations thus covers practically the entire western half of Sardinia, including the Sulcis coal area in the extreme south-west of the island.

Sulcis coal, long a source of insoluble problems mainly due to high production costs and low quality, recorded a fall in output in 1957 of about 2½ per cent (indices 81 and 79 for 1956 and 1957 respectively); this despite substantial subsidies from the Central Government and generous financial aid from the European Coal and Steel Union.

Potash

The development of the extensive Sicilian potash deposits discovered in 1955 and 1956 has been greatly facilitated in that the largest single share—$25,200,000—of the $75,000,000 loan granted by the World Bank to the Italian Board for the Southern Regions (Cassa per il Mezzogiorno) has been earmarked for the opening up of the three main deposits in the provinces of Caltanissetta, Enna and Siracusa, where Montecatini, Società Sali Potassici Trinacria, and Sincat are respectively engaged. A number of chemical industries are to be established in connection with these mines, and it is hoped that in addition to satisfying all home requirements as to fertilizers, etc., a large share of the production will be exported.

Mercury

The Italian mercury industry, second in Europe after Spain, is facing lean times. The output of mercury metal in the first nine months of 1957 was higher at 1,605 tonnes than in the corresponding period of 1956 (1,565 tonnes), but dropped considerably towards the end of the year, mainly as a result of the growing recession both in the U.S., traditionally the industry's best market, and in Europe. Export sales already disappointing, amounted in 1957 to only 992.4 tonnes compared with 2,585.6 tonnes in 1956. Apart from the heavy contraction of American buying, the industry suffers gravely from the substantial production tax on mercury which affects its competitive ability as regards Spain and Yugoslavia. Recent dismissals by the Monte Amiata, the main Italian mercury concern, have been opposed by the trade unions concerned.

Non-Ferrous Metals

Metal ore mining in 1957 exceeded the volume recorded in 1956 by 6.8 per cent. Lead ore showed the greatest expansion (10 per cent); on the other hand the production of copper metal retrogressed by over 21 per cent. The contraction in the output of bauxite (5.4 per cent) was set off by higher bauxite imports (increase, over 150 per cent).

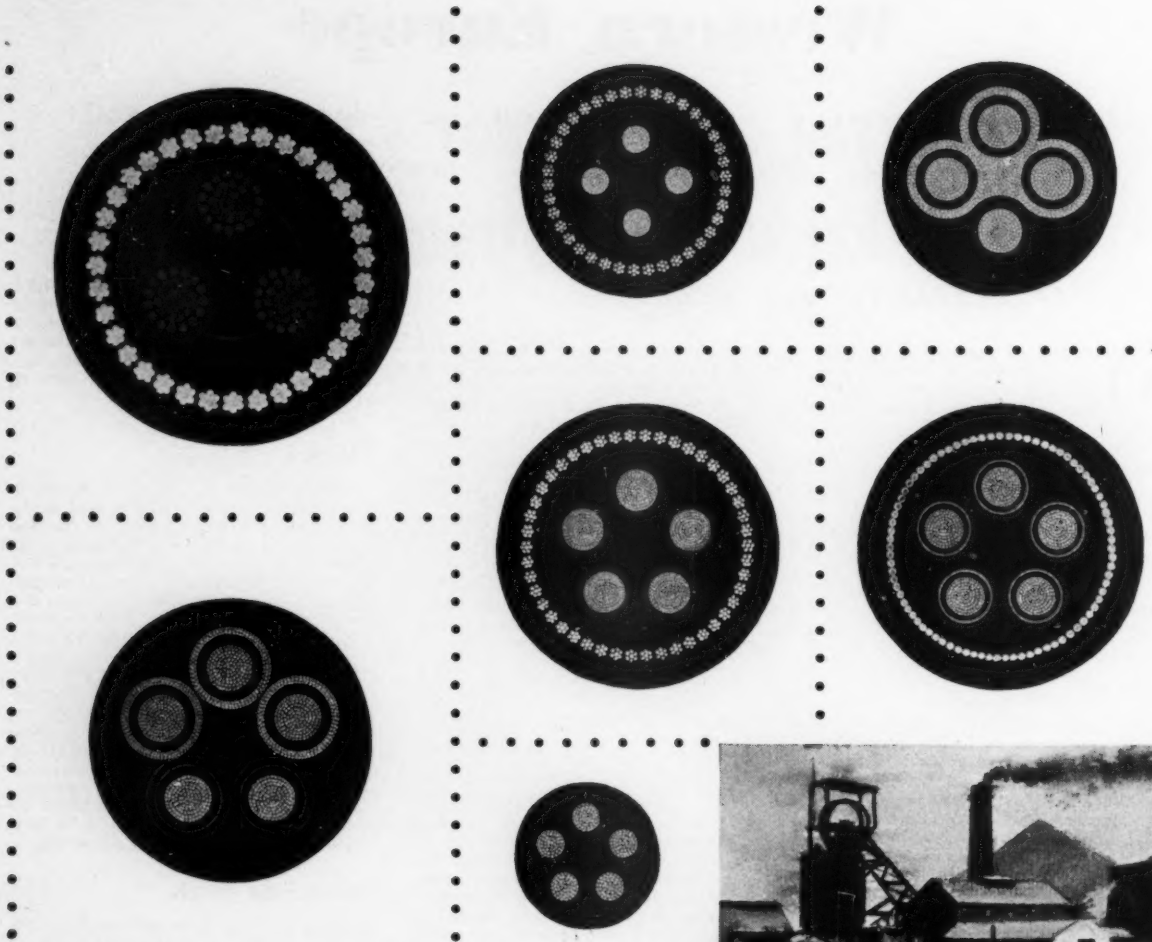
Sulphur

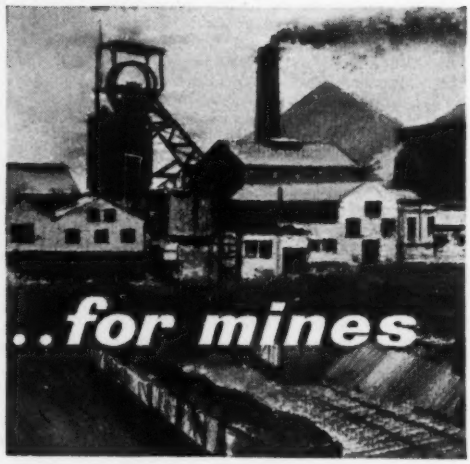
The permanent crisis which Sicilian sulphur mining has been experiencing for a number of years is still continuing despite large-scale Government assistance. Debts which the Palermo Government has to guarantee now exceed 20,000 million lire. Reconstruction plans envisage the closing down of mines whose production costs per

MINERAL AND METAL OUTPUT
(Tonnes unless otherwise stated)

	1956	1957
Aluminium*	173,000	**191,000**
Bauxite	276,000	**261,000**
Copper, metal ..	37,000	**29,000**
Crude oil	628,650	**1,260,000**
Lead ore.....	79,000	**87,000**
Lead, ingot	39,000	**40,000**
Mercury ore	301,000	**365,000**
Mercury metal ..	2,135	**2,180**
Methane (000 cu. ft.) ..	157,900,000	**176,585,000**
Pig iron*	1,717,000	**1,906,000**
Steel, ingot.....	5,914,000	**6,750,000**

* first 11 months for both 1956 and 1957





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ton of sulphur exceed 30,000 lire. On the other hand, negotiations are in progress with a West German industrial group prepared to participate in a large-scale scheme designed to rationalize Sicilian sulphur mining along modern lines. A financial breakdown is said to be unavoidable if help is not forthcoming in the near future.

A deposit of high-grade sulphur suitable for opencast working, discovered in 1957, some 15 miles to the south-east of Rome, near Pomezia, and estimated at 10,000,000 tonnes, is to be developed by the Olin Mathieson Chemical Corporation, New York, jointly with the Italian Rumianca mining concern.

WESTERN GERMANY

By Bergrat (a. D.) van Rossum

IN the year 1957 the output of the more important mining and metallurgical products of the German Federal Republic, with the single exception of coal mining, increased in comparison with the previous year's production. Taking as an index 1936=100, 1957 production in the industry as a whole amounted to 230.9 (1956, 105.9), in mining as a whole to 152.5 (102.1), in coal mining 123.0 (98.9), in the iron ore mines 232.0 (104.7) and in the iron producing industry 160.7 (103.4).

Solid Fuels

The amount of coal mined (all grades included) was 133,156,000 tonnes which constitutes a decrease of only 1,251,000 tonnes or 0.935 per cent compared with 1956, but which is, nevertheless, noteworthy as being the first pause in the production curve, which has risen continually since the war and gradually since 1952. In the production of the European Community for Coal and Steel, which has remained practically unchanged, West Germany's contribution amounts to 53.7 per cent (−0.39). It was obtained in only 290.76 production days (−3.45 per cent) with manpower increased by 1.04 per cent and with overall efficiency increased from 1.388 to 1.413 (+1.8 per cent). The productivity below ground contributed to this improvement with an increase of 1.6 per cent, which could hardly have been achieved but for further progress in the mechanization of mining operations and other improvements.

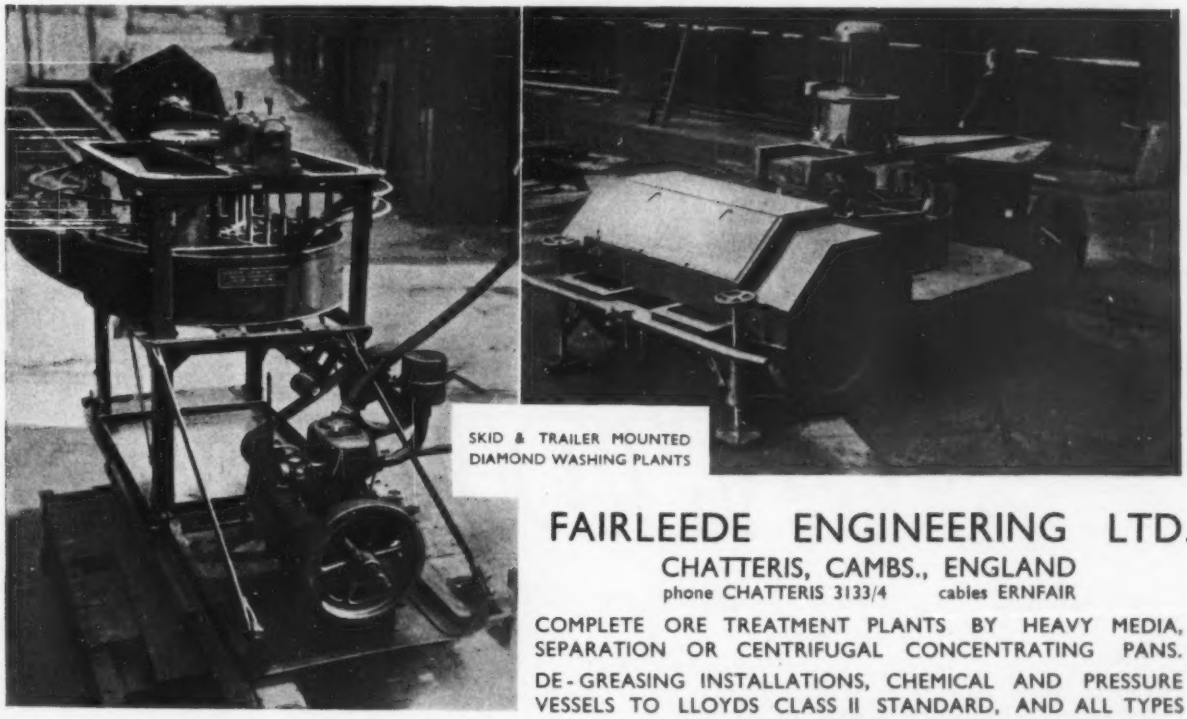
Of the individual stopes 454 (+10 per cent) were provided with mechanical mining and hoisting equipment. These stopes produced 42.8 per cent of the total coal extracted. Their stoping rate per man and shift exceeded the average of all West German stopes by 20.6 per cent and that of non-mechanically mined ones by 36 per cent. In February, 1957, the increase of efficiency compared to manual labour was only 28 per cent.

To the usual, but further improved, machines for cutting and scraping in coal extraction others proved abroad have recently been added, such as the continuous miner and also the Dosco, built under licence in Canada. These have proved very satisfactory under certain geological seam conditions, not frequently found in West Germany. The latest machine is similarly constructed to the continuous miner. Experiments to adapt it here to the more usual method of stoping with long walls seem to promise success. Limits are set to the economy of this and other longwall machines working on a wider surface, in that the supporting of the mined out stope cannot follow quickly enough.

In this respect it become important, that as a result of experience in British mines in particular, the hydraulic pilons and frames made rapid progress in West Germany.

It is hoped that a further improvement in the rate of production will be accomplished by the acceleration and simplification of the supporting process in the mines. But it is clear that by means of the necessary lay-out and equipment of the total underground haulage ways and hoisting of shafts, many of the not immediately productive shifts can be saved. Examples of this have already been offered by some collieries, which have considerably enlarged their field of operations by reconstructing the main shafts without interrupting mining operations, and have used their investment capital instead of for new shaft sinkings for improvements in mechanization bordering on automation.

The increased productivity per man and shift resulting from these developments will become more urgently needed in the future, since the growing demand of the iron and steel industry and power stations for coal from rapidly increasing depths can only be satisfied by a great input of material and energy. A great part of the money spent in



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above ground construction also goes into coke oven plant and into power stations for the collieries themselves and for the equipment of the power generation industry as a whole.

The output from lignite mining has increased to 96,811,000 tonnes (+1.7 per cent) compared with 1956. Again, out of this increase 86 per cent came from the lower Rhine district, rich in deposits, where the transition to deep open cast mining in depth has, meanwhile, been completed in principle. In the year 1965, it seems most likely that there will be not less than 200,000,000 m³ of overburden to shift. Streets and whole villages, even national railway lines have had to give way to the mining industry. The basin of the River Erft, rich in ground water, must be drained to a depth of several hundred metres and a water supply must be created in its place for communities and for industry by sinking large deep wells, for the construction of which a suction drill process improved in the last few years, has proved satisfactory. For the drainage of the water a duct and a canal to the Rhine, in all 26 kilometres, has been built at a cost of 25,000,000 D.M. For the removal of top soil and the production of coal bigger and bigger machines and equipment will be employed; together with simple or diesel electric engines and trucks, and in the stoping itself conveyor belts, which, as is normal practice, can move up to the working face. Special consideration and expense are entailed by the recultivation of the waste tips and the exhausted open workings.

In spite of the enormous capital investment, it is assumed that the products—increasing power from the raw lignite and the manufacture of briquettes—will be cheaper than in the case of energy supplied by coal and oil. The West German output in electrical power is to be increased to 32,600,000 kwh. in 1965 from 15,600,000 kwh. in 1956, of which 8,000,000 coal units (1 ton of lignite = 0.286 tons of coal) are to come from the Rhenish lignite district.

Lead, Zinc and Copper

Copper is now only being recovered in diminishing quantities in the treatment of these and other ores. The mining of lead and zinc has been handicapped since April by the fall in prices, which has come about as a result of the changed attitude of the U.S. Government in connection with the stockpiling of lead. However, since the companies have further opened up their lodes in recent year and have thoroughly improved their works, the output of lead could increase in metal content, compared with 1956, from 65,416 tonnes to 94,280 tonnes (+10.8 per cent), the raw ore efficiency per man and shift having risen to 2.5 tonnes, and that of zinc from 92,345 tonnes to 94,280 tonnes (+2.0 per cent).

The existence of the industry is not threatened, however, for the West German lead and zinc mines in general can manage with a metal price that is 20 per cent lower than the American mines, because the wages paid in the industry constitute only 50 to 60 per cent of the total cost, whereas in the U.S. they constitute up to 75 per cent. Nevertheless, prospecting has to be stopped and the mines closed down. It is assumed that about 1½ times the quantity of raw ore has to be mined to obtain an extracted product which has only risen by 50 per cent, compared with 1936, bearing in mind that since 1957 the efficiency has improved by 57 per cent.

Independently of the latest development in prices, the Gewerkschaft Mechernichert Werke, which for centuries has mined sandstone containing galenite in the areas on the north side of the Eifel, has closed down, the lead production from their own ores having decreased in 1956 from 13,884 tonnes to 12,415 tonnes (−10.5 per cent), owing to deterioration of the ore.

Iron and Steel

The iron ore output of the Federation has again exceeded what is so far the maximum to be reached since the war ended, namely 17,000,000 tonnes produced in 1956, with a raw ore production of 18,320,000 tonnes; i.e., it exceeded the preceding year's production by 7.8 per cent. The number of men employed has risen only by 5.7 per cent, which means an increase of efficiency per man over the year of 2 per cent.

The production of steel has increased to 24,507,000 tonnes (+5.7 per cent). The production of home ore necessary for this output was supplemented by importation, mainly from Sweden. Unfortunately, Sweden now supplies only 40 per cent of her production and is not able to increase her exports as quickly as output grows.

The occurrences discovered at home in the last few years will not be able to contribute much towards the realization of the quantities planned for the Common Market, as mentioned in the previous report. It is characteristic of the situation that considerable amounts have to be shipped from Goa to West Germany, a distance of 12,000 km.

Aluminium

West Germany has no bauxite resources of her own, but there is a considerable and still increasing production of aluminium metal. The amount produced in 1956 was about 147,400 tonnes and rose to 153,838 tonnes (+3.9 per cent) in the year under review, i.e., 3¼ times the quantity produced in 1936. For this output the aluminium industry is more than 80 per cent dependent on import. Its position will become difficult in the Common Market and the Free Trade Area *vis-a-vis* that of other competitors who have at their disposal in overseas countries abundant ore deposits, cheap energy and sufficient labour.

The Vereinigten Aluminiumwerke A.G., which in the year 1956 was responsible for 71 per cent of the West German production and the rebuilding of the Erftwerke, has again reached its yearly target of 120,000 tonnes or 50 per cent of its former production capacity. To provide for its own energy requirements the company acquired Rhenish lignite fields, which will supply a power station of 150,000 kwh. to be erected at a cost of 60,000,000 to 70,000,000 DM.

FRANCE *By R. M. Block*

A GOOD and stable economy was again enjoyed by France in 1957, a condition which has been maintained since 1954 and which shows signs of being continued in the future.

Solid Fuels

Coal production reached a new record level of 59,000,000 tonnes, which was a 3 per cent increase on the figures for 1956. This result was obtained by increasing efficiency and also by the recruitment of a larger number of underground workers.

Consumption increased by about 2,000,000 tonnes.

Oil

French production of crude oil is still rising. Output has now passed the level of 1,400,000 tonnes, without taking into account production of natural gas at Lacq and St. Marcet, where it was well over 400,000,000 cu. metres in 1957, and may be expected to reach 650,000,000 cu. metres in 1958. Imports of crude oil treated in French refineries were about 7 per cent less than in the previous year, due to shortage of currency which tended to slow down deliveries, this in turn resulting in higher prices and a consequent fall in demand. The quality of production was, however, improved, mainly thanks to the installation of desulphurization units.

On the French domestic market, consumption of fuel-oil for home use was estimated to have increased by 20 per cent (mainly in agricultural use), but consumption of other oil products dropped slightly in 1957.

Capacity of tankers, which should reach a level of 3,000,000 tonnes in 1961, will increase by about 275,000 tonnes in 1958.

METAL and MINERAL OUTPUT
(in 000 tonnes)

	1956	1957
Crude oil	1,262.8	**1,415**
Natural gas*	330.7	**446**
Aluminium (metal)	149.8	**160**
Bauxite	1,461.9	**1,680**
Coal and lignite	57,392.8	**59,088**
Copper (electro)	20.0	**19.2**
Iron ore	52,704.3	**57,766**
Lead (metal)	63.3	**73.8**
Nickel (metal)	5.2	**6.5**
Potassium (K_2O)	1,500.0	**1,576.0**
Pyrites	303.8	**323.5**
Zinc (metal)	112.6	**130.5**

* Millions of cubic metres.

Iron and Steel

In spite of various strikes, cast iron production increased by 4 per cent above the level of the preceding year, attaining a figure of almost 12,000,000 tonnes. Steel output was over 14,000,000 tonnes, an increase of 5 per cent on last year. The Plan is based on an output of 18,000,000 tonnes of steel in 1961, and it now seems that this should be achieved without encountering a great deal of difficulty.

Imports of steel reached their highest point in October; Belgium is drawing on her stocks.

Output from the iron mines was satisfactory (57,800,000 tonnes) and deliveries of ore occasioned no anxiety. Increased production was particularly noteworthy in the mines of Moselle and Meurthe-et-Moselle (10 per cent); stocks have been considerably increased, both in the workshops and on the

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site. It is clear that French iron mines are producing at a higher rate than required by the steel industry, and that their capacity will be well in advance of requirements by 1958.

Increased efficiency has been achieved in terms of technical progress; by the end of the year a level of production was reached which almost doubles the figure recorded for 1938.

Light Metals

French bauxite output overtook the level reached in 1956, and it was the same with aluminium, the consumption of which increases favourably. Production of magnesium showed a slight drift downwards towards the end of 1957, and supplies were not quite equal to the demand. The results of trials at the pilot plant at Baudean are very encouraging.

Lead, Zinc, Tin, Copper, Pyrites

Production of lead ore and metal showed a clear increase. There was also a perceptible rise in the production of zinc ore and metal. With regard to tin, however, the last productive mine in France had to close down at the end of December. As is well-known, France has no copper ore, and produces no primary copper. The production of pyrites showed a slight increase compared with that of 1956.

Gold

Production of gold matte was a little lower than that of the previous year. However, since the grade was a little higher, the quantity of contained gold remained about the same.

Nickel, Cobalt, Tungsten

There was a marked rise in the production of nickel, to the extent of about 25 per cent over the 1956 level. The high price of New Caledonian nickel compared with the world price, however, puts the French manufacturers of nickel-steels in a difficult position, and confers an advantage on imported fine grade steel. Cobalt metal production was slowed down by the difficult supply position of the Moroccan ore. The drop in the market price of tungsten caused the closing of three mines out of six.

The Ferro-Alloys

Production of ferro-manganese was maintained. It should be noted, however, that this French industry might one day be faced with a difficult situation in marketing its product when ferro-manganese manufactured in Africa, which will be producing at an annual rate of 200,000 tonnes, finds its way to world markets.

The manufacture of ferro-silicon shows an increase, but that of ferro-chrome was a little lower, in the face of growing demand abroad.

Potassium

The extraction of potassium salts by the mines of Alsace reached a new record, increasing by about 4 per cent on the figure for the previous year. Efficiency was improved in underground working, and deliveries of refined salts increased by 7 per cent.

PORTUGAL

THE steep decline in tungsten prices has had serious consequences for Portugal's mining industry. In the first half of 1957 output of wolfram concentrate amounted to 1,886 tonnes against 1,841 tonnes in the corresponding period of 1956. By the middle of the year, however, only a very few long-term contracts remained to be cleared off. June exports of tungsten ores from the northern area totalled just over 50 tonnes, against an average monthly figure of 100 tonnes in January-June, 1957. By the middle of the year mines generally were endeavouring to dispose of stocks, and it had become apparent that, if no improvement took place, Portugal would soon have fewer than six active mines, representing a mere 5 per cent of total capacity. Care and maintenance was being applied only to some of the larger mines, the majority being abandoned. Once a mine had closed down, it takes a considerable time for normal production to be restored. Moreover, producers have been forced to concentrate on the better sections with adverse effects on future production.

The Government has been petitioned for assistance, but the only real help that could be given would be the removal of all export duties and of the numerous extras charged by the Custom Houses, both possibilities being regarded as remote.

Two new electric furnaces have been added to the national tin smelter, set up a few years ago, which has enabled tin to be sold to Brazil at 10 per cent above prevailing world prices.

Beralt Tin and Wolfram Ltd. has announced plans for a further increase in the production of tin concentrates. The rate of production has already risen to nearly 40 tonnes per month. Nearly all the extra output will come from the Vale de Ermida and Argimela properties, which are now under development.

The gold mine at Penedono, Viseu District, has been closed and the workers discharged. The Jales Mine (Vila Real District) now seems to be the only gold mine in Portugal which is operating on any scale.

The Siderurgia Nacional S.A.R.L. has contracted to purchase the major part of the equipment for the establishment of a steel industry in Portugal from the German firm of Demag. An important factor influencing the placing of this £17,000,000 order with Demag has been the sale of the Moncorvo iron mines in North Portugal by Rheinstahl, a participant in the German group, to Siderurgia Nacional. Production is about 25,000 tonnes monthly, which is at present being exported. The main works will be established in the area of Seixal on the south bank of the River Tagus near Lisbon, and not at Alcochete, 10 miles to the north-east, as previously announced. Siderurgia Nacional estimates that by 1960 it will be able to produce 200,000 tonnes annually. The ultimate target is 300,000 tonnes. Iron and steel form the largest single group of Portuguese imports.

For the time being the project to establish a tinplate mill, which was provided for in the 1953-58 development plan, appears to have been postponed, if not abandoned.

As undeveloped sources of water power diminish, the Portuguese Government is planning a series of power stations which will make possible fuller exploitation of the country's reserves of low-grade coal and also of her uranium resources. No information has been released as to Portuguese reserves or current production.

Preliminary work has started on a site near Lisbon for the Atomic Energy Centre. In addition to an experimental reactor and two particle accelerators, there is to be a pilot plant for refining Portuguese uranium ore.

PRINCIPAL MINERAL EXPORTS

(In tonnes)

	1956	1957
Tungsten Ores ..	4.374	2.786
Cassiterite	118	158
Tin Metal	220	139
Cupreous Pyrites ..	408,574	300,295
Burnt Pyrites	188,501	193,720
Manganese	3,880	3,633
Hematite	167,462	158,322
Magnetite	72,602	98,982
White Arsenic	1,505	1,191

SPAIN

COAL production in Spain was rated at 16,000,000 tonnes in 1957 compared with 14,600,000 in 1956, steel output rose to 1,340,000 tonnes (1,220,000) and pig iron output to 930,000 tonnes (850,000). Over the period January-June, 1957, increases were recorded in the outputs of most metals and minerals as compared with the corresponding period of 1956. Iron ore production rose to 498,000 tonnes, a gain of 18.5 per cent, pyrites to 1,207,000 tonnes (3.5 per cent), aluminium to 7,350 tonnes (18.5 per cent), copper to 3,450 tonnes (10.5 per cent) and potash to 125,000 tonnes (9.5 per cent).

E.N.D.A.S.A. (Empresa Nacional de Aluminio, S.A.) is the Spanish producer with the greatest experience in the production and marketing of aluminium and aluminium products. In 1953 this company erected a factory at Valladolid with a planned production of 10,000 tonnes of refined aluminium a year. A second and larger factory is now being established on the estuary of the Aviles River, in the vicinity of the Aviles steelworks. The first stage will come into operation by the end of 1958 with an annual output of 7,500 tonnes and by 1960 the factory is expected to be completed and running at full capacity. By that date E.N.D.A.S.A. will be producing a total of 25,000 tonnes of aluminium a year, which approximates to the country's present requirements.

The French firm Seichime has formed, with Spanish banking interests, a 100,000,000 peseta company known as Aluminio de Galicia to build and operate an aluminium plant with a maximum annual output of 20,000 tonnes at La Coruna in Northern Spain. Seichime, which is a holding company controlled by Péchiney, will participate in this venture through the Spanish firm Aluminio Espanol.

The Spanish company, Aluminio Iberico S.A., has put forward a proposal to set up an aluminium and aluminium alloy plant in the neighbourhood of Madrid at a capital cost of 300,000,000 pesetas. Annual produc-

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tion would include 4,000 tonnes of primary aluminium.

The Spanish banks Herrero and Banco Espanol have been authorized to set up jointly a company for the production of electrolytic zinc under the name of Asturiana de Zinc S.A. The Belgian owned enterprise Real Compania Austuriana de Minas with headquarters in Madrid is participating in the new concern to the extent of 40 per cent. Foreign participation in newly-formed companies is normally limited to 25 per cent by law. Furthermore, a decree published in November, 1956, prohibits foreign participation in Spanish zinc mines or zinc smelters.

A new coal mine, stated to be one of the most important in Spain, has been put into operation at Turon, in Asturias, by the Hulleras del Turon company. Output is expected to reach 600,000 tonnes of bituminous coal per annum.

In September, 1957, General Franco opened the first furnace at the State-sponsored Avila steelworks. The furnace was designed and erected by Head Wrightson & Co., of Britain. Steel production is expected to reach an annual level of 1,390,000 tonnes by 1960 and 2,500,000 tonnes by 1965.

The Spanish mining concern Union Espanole de Minas Metalicas has applied for permission to carry out prospecting work on occurrences of lead ore in the vicinity of Navalonguilla, province of Avila. Numerous applications have been received to prospect for various types of ore in the mining districts of Almeria Badjoz, Caceres, La Coruna, Lugo, Oranse and Pontevedra.

EIRE *By M. V. O'Brien*

FALLING base metal prices in 1957 brought curtailment to some prospecting and, by the year's end, a serious threat to the lead-zinc producers. On the other hand there was rather more activity in non-metallics and an all-time record for coal production.

A number of prospecting operations, initiated in 1956 following introduction of tax concessions for new mines on non-bedded mineral deposits, ceased in mid-1957. In most cases there were announcements that work was "suspended pending study of results," and the prospecting licences were not relinquished. Among these were groups with Canadian associations at the old mining districts of Glendalough, County Wicklow (lead-zinc), Bunmahon, County Waterford, Schull, County Cork, Hollyford, County Tipperary (all copper), at the gold bearing antimony veins of Clontibret, County Monaghan, and on a regional survey for copper, lead and molybdenite in W. Mayo and W. Galway. In each of these a geophysical survey or a diamond drilling programme or both had been carried out.

The most elaborate exploration programme launched in 1956 was at Allihies, County Cork. It continued uninterruptedly through 1957. There, in the extreme S.W. tip of Ireland, an extensive diamond drilling programme gave way to the dewatering of the principal old workings. At 1,500 ft. below adit they were the deepest in the country. During the year access was gained to progressively deeper parts. After the year's work the company, (Emerald Isle Mining Company, an Irish subsidiary of Can-Erin Mines Ltd. of Toronto) announced that it was reasonable to look forward to the proving of 1,000,000 tons of good grade copper ore associated with the ore shoot under examination.

From Avoca no new exploration results were announced. St. Patrick's Copper Mines Ltd. (whose Canadian parents are Irish Mines Ltd. and Mogul Mining Corporation) were fully occupied in development. Their deposit has already been proved to have well over 20,000,000 tons grading 1.11 per cent copper with additional by-product pyrites and, in part, lead and zinc also. Underground the first 4,000 ft. of 17 ft. x 17 ft. inclined (1 : 8) haulage artery has been used as a base for driving the system of crosscuts and subsidiary openings in readiness for stoping. On surface, mill buildings and equipment for 4,000 tons daily output are

MINERAL AND METAL OUTPUT
(in l.tons)

	1956	**1957**
Lead (metal in concs.)	2,558	**2,012**
Zinc (metal in concs.)	1,917	**1,572**
Barytes	7,422	**8,083**
Gypsum	108,016	**130,346**
Silica	3,895	**1,348**
Semi-Bituminous coal	60,060	**87,466**
Anthracite	153,049	**160,641**

All figures are provisional.

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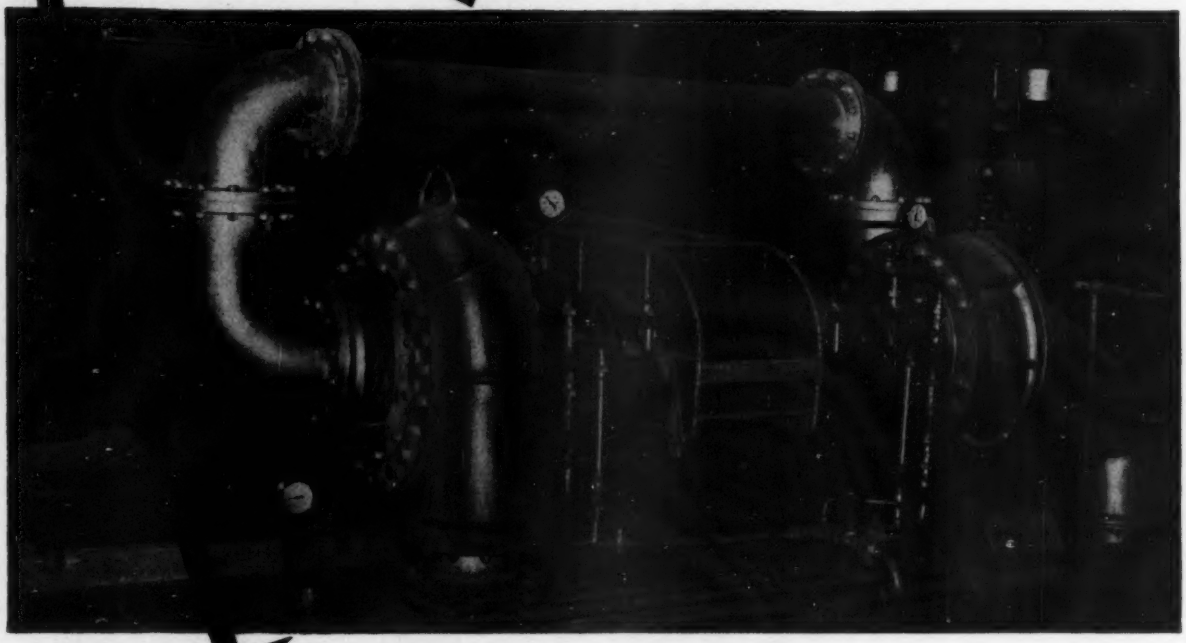

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advancing towards a start of production in mid 1958.

Abbeytown Mining Company producing lead and zinc concentrates in County Sligo and Silvermines Lead and Zinc Co. with ores of argentiferous galena in County Tipperary continued in operation throughout the year. In the latter reduced ore grade was balanced by increased tonnage. In the face of continuing low metal prices production at Silvermines was suspended in January 1958 and at Abbeytown in March. Some exploration and development is continuing and equipment at both mines is intact in readiness for resumption.

Barytes continues to come from the 15-year old mine in County Sligo and also became a saleable by-product of the Silvermines Lead and Zinc Company. Prospecting licences have been taken up in S.W. Cork, an area which produced substantially before and after 1900 but which has only had dump recovery output in recent years.

Limestone is quarried on a large scale for cement and agricultural use. On the crystalline calcite deposits of County Clare one company has long experience of production and another is prospecting. Silica production for ceramics continued in E. Cork.

Coal production at 248,000 tons is the highest annual total recorded. This comes from expansion by existing companies under the stimulus of good prices and fuller use of slack coal, for instance in the cement industry. There is a small export business in low volatile anthracite, some of which is suitable for carbide manufacture. With the approaching completion of a coal-fired generating station near the Connaught field the production increase is likely to continue. Company coal exploration has spread into the Munster anthracite field where structural complexity has long hindered development. A State financed exploratory programme, mainly for the Leinster coal field, has been announced.

THE BRITISH ISLES

By H. Y. Robinson, M.Sc., M.I.M.E., A.R.I.C.S.

A FALL of one-third in the price of lead and zinc has had quite serious repercussions on lead-zinc operations in both Eire and the British Isles. In Wales, during the last few years Halkyn District Mines have made substantial additions to their reserves although the ore was of poorer quality and the development also included work on the sea level tunnel. Now comes the news that the Halkyn Mine is to close down on April 19, when it is reported that more than 150 out of the 200 workers will become redundant. Fifty workers will be engaged underground at Rhyd-y-Mwyn getting limestone. It is understood that the workmen will be compensated according to length of service and mining operations will not be resumed until market prices are more favourable.

The same dismal picture comes from the Parc Mine of the Llanrwst Lead Mines, a subsidiary of J.C.I. As the grade of ore declined, development in depth was the hope for better things and although the concentration plant was capable of producing high-grade lead and zinc concentrates, recently, due to falling market prices, 75 workers were paid off.

Meanwhile, with Weardale Lead Co. the picture is a much happier one. A year ago it was reported that after heavy development expenditure the company had achieved a more sound basis for the future. This was at a time when a comprehensive dressing plant capable of producing both gravity and flotation concentrates had been completed at the company's Stotsfield Burn Mine and the annual report had shown a trading profit. This confidence has been well justified and trading profit has been increased but it must be appreciated that the falling market price of lead is not so crippling, since the company also produces both acid grade and metallurgical fluorspar, the market prices for which have remained steady.

At the nearby Stanhopeburn Mine of Fluorspar Ltd., where fluorspar-galena ore is also being mined, the output of acid grade fluorspar was maintained. Some 70 to 80 tons of galena concentrates were also produced but rising costs and marketing difficulties reduced the trading profit as compared with the previous year.

Anglo-Austral Mines Ltd. have continued operations at Heights Pasture Mine, Eastgate, and the plant at Rampgill Mill, Nenthead, has been supplying acid-grade fluorspar concentrates to the parent company's operations at Avonmouth.

The demand for metallurgical fluorspar has been responsible for the activities at the West Blackdene Mine of the Beckermet Mining Co. Ltd., and at the Ramshaw and Groverake Mines of Blanchland Fluor Mines Ltd. Plans for the further reorganization of the dressing plant at Ramshaw appear to be held in abeyance as the reopening of Groverake Mine is showing considerable promise and it may well be that future dressing operations will be centred at this mine.

In Scotland at Leadhills, and in England at Greenside, interest is still being maintained.

Coldberry Lead Mines Ltd. have continued to get galena from the Great Limestone and, in addition to prospecting in the lower levels of adjacent disused mines, have successfully located, using geophysical prospecting, a vein of galena-fluorspar ore which outcrops quite near the present Coldberry Adit.

New Consolidated Goldfields have also progressed with their prospecting by drifting and diamond drilling at Swinhope near Allenheads and some of the lead-zinc ore has been submitted to laboratory tests.

At Settlingstones Mine and at the National Coal Board's Holmside Mine prospecting for witherite has also gone on. The owners of the former are at present exploring in the old Fallowfield Mine.

Mining has also continued vigorously at the Billingham Anhydrite Mine of Imperial Chemical Industries, at Sandwith by Solway Chemicals Ltd., at Cocklakes by the Carlisle Plaster & Cement Co. and at the Subwealden Mine of Gypsum Mines Ltd. in Sussex.

Steady progress has also been made at the Gasswater Barytes Mine of Anglo-Austral Mines Ltd. in Ayrshire.

The output of stratified ironstone from the mines of the Cleveland district amounted to more than 500,000 tons. Much of this was got with mechanical loaders but, with the dangers of the heavier than air inflammable gas fully appreciated, most of these are compressed air operated. Recent analyses of "Cleveland Gas" have shown the presence of ethane and other higher hydrocarbons up to and including hexane. These mines are operated by Dorman Long & Co. Ltd., Pease & Partners Ltd. and Skinningrove Iron Co. Ltd.

It is hoped eventually to raise home production of iron ore from something like 16,000,000 tons to more than 20,000,000 tons in 1962 and, while opencast mining in Northampton will be expected to produce most of this increase, output from the stratified ironstone mines of Cleveland and from the Cumberland hematite mines will certainly be important. These latter include the Hodbarrow and Moorbank Mines of the Hodbarrow Mining Co. Ltd., Florence Mine of the Millom & Askam Hematite Iron Co. Ltd., Ullcoats Mines of the Ullcoats Mining Co. Ltd., and Beckermet & Haile Moor Mines of the Beckermet Mining Co. Ltd.

CORNWALL AND DEVON

By F. B. Michell, B.Sc., A.C.S.M., M.I.M.M., M.I.Min.E

AGAIN this year there have been no major developments in the area. During the summer the Geological Survey in conjunction with the A.E.A. carried out an airborne geophysical survey in West Cornwall, the actual aerial operations being undertaken by Hunting Aerosurveys Ltd. As a result of this work some areas have been delineated for further exploration and one area on the site of Roskrow United Mines, otherwise known as South Tresavean mine, which worked last in 1870, has been examined.

Pumping was commenced to enable the examination to be made, but it is understood nothing of economic interest was discovered and no further work is being done. Some coffinite was identified, however, being the first to be discovered in this country.

An adjoining mine has also been examined, in an area where a small quantity of cobalt was produced many years ago, whilst some further examinations are being carried out at Egloshellan Mine, St. Stephens; near Altarnum on the Bodmin Moor, and in the Helston-Breage district.

It has long been known that uranium was present at Roskrow mine as well as some silver, copper and nickel which was reported when the mine was working. The water discharged from the adit has been found to be

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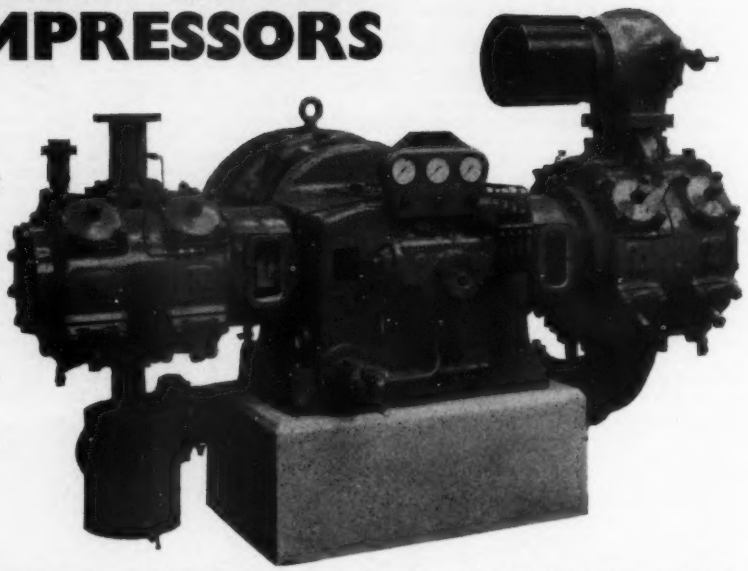

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radioactive and for a time it was sold for its "medicinal" value.

At Geevor Tin mine, the tonnage of ore mined amounted to 66,041 tons of which 63,281 tons were milled, the remainder being sorted waste rock. Some 702 tons of tin concentrate (65 per cent Sn) was sold which was an increase of 50 tons compared with the previous year whilst the tonnage milled also exceeded that of last year by 7,877 tons. The average recovery was 24.85 lb. of black tin per ton milled.

The total footage of development at 8,601 ft. was almost the same as in the previous year and development work on lodes was confined to the Wethered, Wethered No. 2, Borehole, Coronation, North Pig (north branch) and the North Pig (south branch) lodes as well as some branch drives.

The ore reserves at 184,112 tons were slightly higher than last year but the grade was slightly lower.

During the year the flotation section of the plant was modified and rebuilt, incorporating a regrinding and a float cleaning unit, which has resulted in an improvement in extraction and a worthwhile reduction in operating costs. In the year ending December, 1957, 693 tons of black tin were sold.

At South Crofty mine, the only other major producer in Cornwall, the reconstruction of the primary treatment plant has been almost completed.

In August last, the new classification system and modified layout of the table plant was put to work, which included new middling regrind units and considerable additions for handling the finer sizes. The H.M.S. plant and the secondary crushing and screening plant have just been completed and the final stage of the modernization involving replacing the stamp battery by a rod mill will soon be in hand.

Work on the new construction was financed during the year 1956-57 out of the company's resources but the report stated that further borrowing would have to be made for the purpose of financing the remainder of the reorganization. In November, the directors issued the results of operating over the past nine months showing an estimated revenue from mineral sale of £272,600 with an estimated expenditure of £277,700 and pointed out that the working expenditure had risen sharply without increase in overall productivity, whilst the price of tin had fallen. Considerable expenditure had been incurred in plant modernization but the effect of the bulk of the new equipment could not improve net revenue until early in 1958, it was stated. Development reached a new record last year and during 1957 about 720 tons of black tin were produced.

Elsewhere in Cornwall, the reconstructed and enlarged plant of Hydraulic Tin Ltd. at Bissoe, near Truro, was put into operation in the autumn. The new flowsheet involves washing, screening, rejecting considerable almost barren oversize, concentration on Humphreys spirals for sand sizes and on a Buckman frame for slime. Rougher concentrate is reground and retreated on tables after extensive classification and finally sulphide minerals are removed from the table concentrate by flotation followed by magnetic separation to remove iron oxides.

Minerals Recovery Ltd., treating the sand from the beach at Gwithian, ceased operation during the year but some other small operators on tailings continue to work.

The small wolfram mine at Hawkswood, now owned by the Pena Copper Co., continued production on a small scale, but all production ceased from Great Western Ores' wolfram mine at Castle-an-Dinas. This company was a subsidiary of South Crofty Ltd.

English China Clays Ltd. reported a small but encouraging increase in sales, and whilst home market sales fell slightly, the export sales increased in spite of the effects of currency, import and other trading restrictions. The sales of molochite showed a marked increase and a growing interest was reported overseas, especially in the U.S.A. However, a falling off in the trade of the building subsidiary was noted.

During the year the company extended their interests in road stone and limestone quarries and, in addition, acquired all of the shares in Hexter and Budge Ltd., ball clay producers of Newton Abbot.

The report showed that work was being undertaken to increase the mechanization and reduce costs in the quarrying undertakings whilst, of course, it is well known that the company has been modernizing its clay production for some years and completed a new plant at Blackpool in the St. Austell district for clay processing last year.

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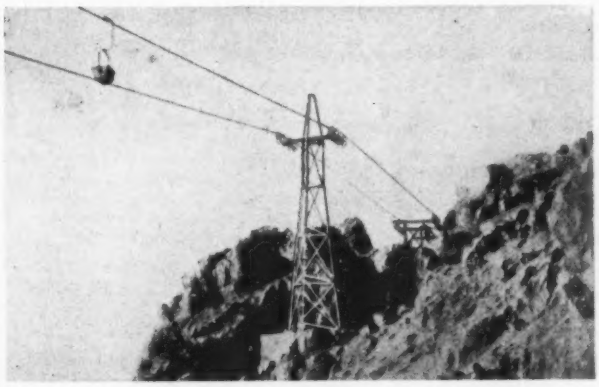

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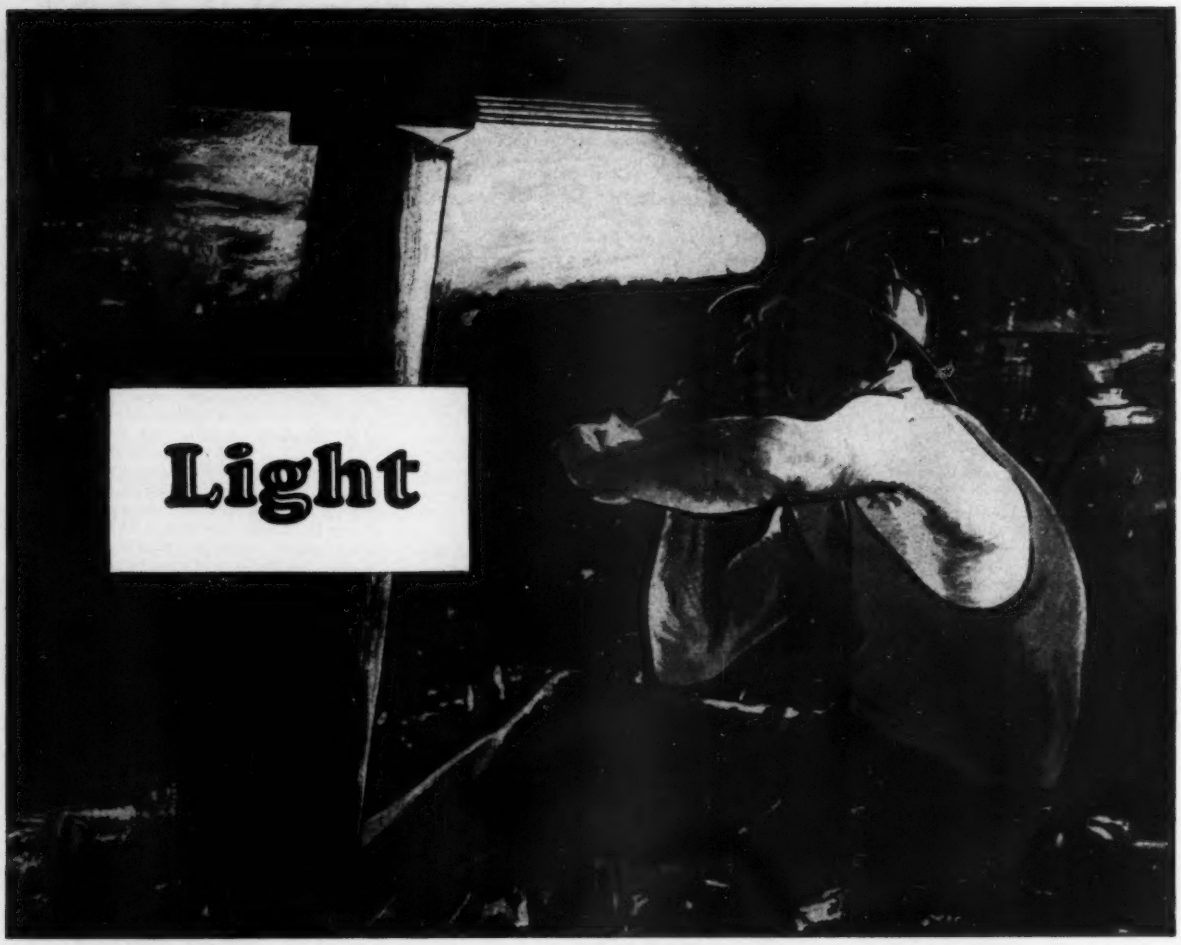

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Northern Europe

FINLAND • NORWAY • SWEDEN • DENMARK

FINLAND *By Herman Stigzelius, D.Tech.*

THE activities of the Finnish ore mines continued uninterruptedly in 1957 and production increased almost everywhere. The total quantity of ore and waste rock extracted amounted to about 2,400,000 tonnes as compared with about 2,100,000 in 1956. Productive mining was carried out in 1957 at the Outokumpu, Vihanti, Ylöjärvi, Aijala and Metsämonttu mines, owned by Outokumpu Oy, at the Otanmäki mine, owned by Otanmaki Oy, and at the Haveri mine, owned by Oy Vuoksenniska AB.

At the Outokumpu mine, which is the largest producer of copper and pyrites concentrates in Finland, ore extraction totalled 672,000 tons. Moreover, some old dressed waste products were processed at the mine for the purpose of extracting residue pyrites concentrate. The copper concentrate is further refined at the company's smelting plant in Harjavalta and the metal works in Pori. The pyrites concentrate is used at the sulphite cellulose and sulphuric acid factories.

CHIEF MINERAL PRODUCTS
(tonnes unless otherwise stated)

	1956	1957
Pyrites concentrate	293,000	**297,000**
Iron ore concentrate ..	203,000	**210,000**
Ilmenite concentrate....	103,000	**106,000**
Zinc concentrate	75,000	**81,000**
Cathode copper.....	22,450	**25,800**
Lead concentrate	2,600	**4,500**
Vanadium pentoxide....	74	**469**
Tungsten concentrate ..	59	—
Silver .....kg.	9,900	**11,620**
Selenium ..... ,,	3,800	**4,182**
Gold..... ,,	600	**696**

The Vihanti mine, the country's most important exporter of zinc concentrate, raised extraction to about 400,000 tonnes of ore. In addition to zinc concentrate, this mine produces small quantities of copper and lead concentrates.

At the Ylöjärvi copper mine preliminary work is in progress to double the annual production. These preliminary operations were more or less completed during 1957. There was no production of tungsten concentrate, as in previous years, because mining was concentrated on ore areas where tungsten is non-existent.

At the Aijala and Metsämonttu mines the known ore reserves are becoming exhausted, but a comprehensive prospecting programme is being carried out to discover new ore deposits. The principal product at the Aijala mine is copper concentrate. At the Messämonttu mine the zinc-pyrites ore concentrates were fully worked towards the end of 1957 and mining was directed on a separate ore body which contains lead, copper and gold.

In 1957 the Otanmäki iron ore mine reached the highest production among the Finnish ore mines, when rock extraction amounted to 802,000 tons. At the coarse screening process, before the actual dressing, 173,000 tons of coarse macadam were separated for the requirements of the Finnish State Railways. The principal products of the mine are iron ore concentrate and ilmenite concentrate, as well as vanadium pentoxide separated from the latter concentrate. For the purpose of increasing the production of vanadium, the vanadium works are being expanded and these new installations were almost completed at the end of 1957.

At the Haveri gold mine the ores worth mining are almost entirely exhausted and the mine can only be kept in operation for a few months.

Of the seven ore mines at present in operation three must cease operation in the near future, probably during 1958, because of scanty ore reserves. In spite of this, the future prospect of the Finnish mining industry would appear to be bright because the relatively small mines at which mining is to cease will be replaced by new considerably larger mining enterprises. In 1957 Outokumpu Oy commenced the erection of buildings at the Kotalahti nickel-copper deposit in the parish of Leppävirta. The quantity to be mined annually is estimated at 300,000 tonnes and production is calculated to begin in 1959.

Oy Vuoksenniska AB has continued with preliminary constructions at the sub-marine iron ore deposits at Nyhamu and Jussarö in the south-west archipelago of Finland. The shaft at Nyhamn, which is being sunk on a small island, reached a depth of 295 m. in 1957 and drift driving has commenced on the 255 m. level to the ore, which is located at a distance of 1,600 m. from the shaft. Shaft sinking also began at Jussarö in 1957 and a depth of 100 m. had been reached by the end of the year.

The State enterprise, Suomen Malmi Oy, has stated that new important ore deposits have been discovered in the Kolari iron ore region in the north of Finland.

NORWAY *By Per Sandvick*

THE year 1957 was a fairly good one for the Norwegian mines, apart from the downward trend of the prices for copper and zinc. The value of the production from the Norwegian metal mines was about 250,000,000 Norwegian Kroner.

No particular changes in mining methods took place. It may, however, be mentioned that longhole blasting is gaining ground, the drilling being performed by extension steels with detachable tungsten carbide bits. To obtain faster penetration there is a tendency in drifting to use heavier drills mounted on airlegs.

Prospecting has been carried out in several regions. In the county of Finnmark several investigations took place, among them being continued geophysical prospecting and diamond drilling by Kautokeino Kobberfelter. In Repparfjord the Canadian company, Invex Co. Ltd., has commenced examination of some old copper prospects by diamond drilling. The State's investigations of the old Birtavaara mine and the Vaddas prospect did not reveal ore of satisfying grade and quantity. In the Southern part of Norway some smaller iron and pyrites ore-bodies are being investigated.

The iron mines had a year with few troubles. The largest producer, A/S Sydvaranger, had the best year in the 51-year-long life of the company. Draining of the lake Björnevann this year has made another part of the orebody available for opencast mining. The depth at the export quay is now increased by dredging, making it possible to accommodate cargo vessels up to 20,000 tonnes.

Fosdalen Bergverk A/S has reported a certain reduction of the output for the coming years until the recently discovered Eastern part of the ore-body is ready for production of magnetite ore.

The ilmenite producer, A/S Titania, near Egersund, in the South of Norway, has obtained a concession to utilize its newly found orebody at Telneset. This orebody is situated about 2½ miles from the old mine and 60,000 ft. of diamond drilling has indicated a quantity of 350,000,000 tonnes, three times more than originally anticipated.

CHIEF MINERAL OUTPUTS
(In thousands of tonnes)

	1955	1956	1957
Iron ore and conc.; Ilmenite conc.....	1,413	1,730	1,697
Copper conc.....	26.6	28.3	**29.9**
Pyrites.....	843	850	**831**
Zinc and lead conc.	15	15	**14.5**
Molybdenum conc.	0.28	0.77	**0.29**
Niobium conc. (50% $Nb_2O_5 + Ta_2O_3$) ..	0.30	0.26	**0.22**

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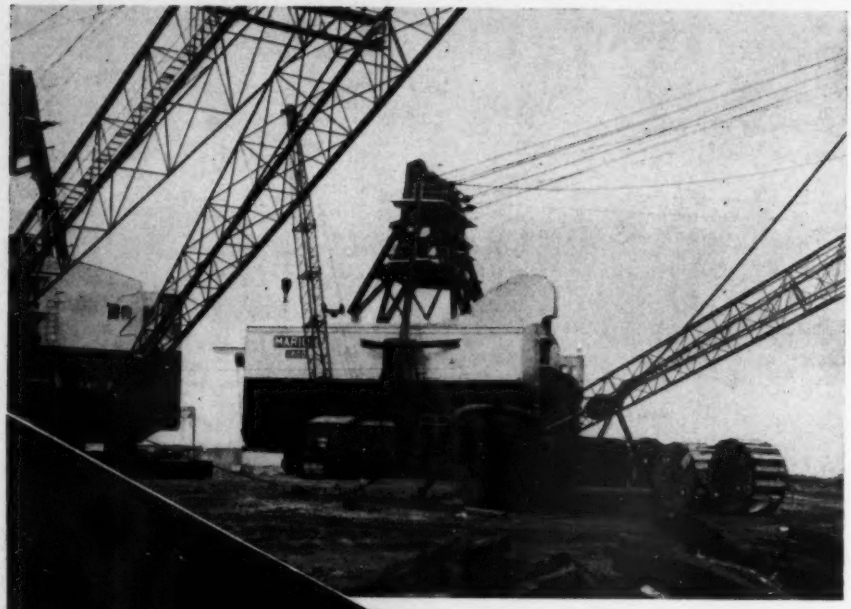
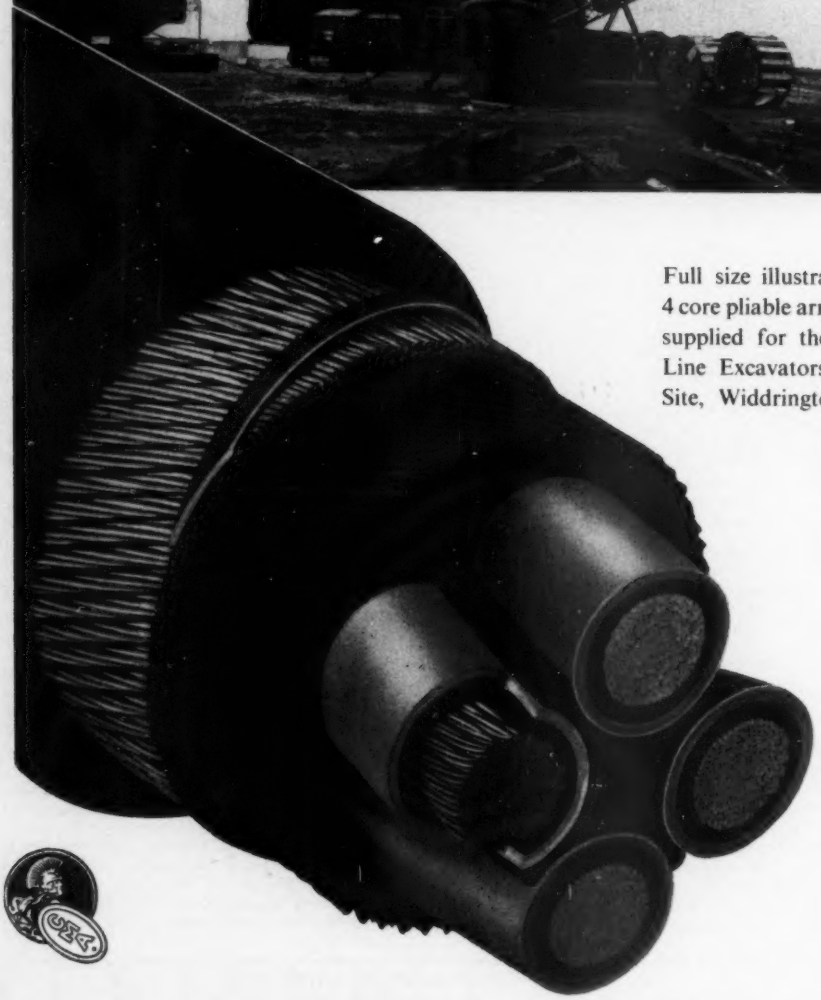


Photograph by courtesy of The National Coal Board—Opencast Executive, and Messrs. James Miller and Partners Limited.



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Opencast mining operations will commence in 1960 after a sum of about £3,750,000 has been invested. The present production of about 180,000 tons of ilmenite concentrate per year will be stepped up considerably.

The 50-years-old Stord iron pyrite mine near the town of Haugesund in Western Norway has been celebrating its anniversary. This mine is situated on the coast and mines the lowest grade ore in Norway. Another pyrite producer, A/S Folldal Verk, situated in the Midland, has announced discovery of a pyritic orebody in the Dovre mountains at Hjerkinn railway station, 3,300 ft. above sea level. Bleikvassli mine, Mo i Rana, was opened in September. As the result of an expansion and development scheme costing £750,000, this mine may eventually deliver 100,000 tons of ore per year for production of 18,000 tons of zinc concentrate, 4,000 tons of lead concentrate, and 35,000 tons of iron pyrites. A/S Sulitjelma Gruber, which previously had to transport copper and concentrates by railway and lighters to the sea, has this year got direct railway connection with the shipping port at Finneid.

In various parts of the country substantial production of non-metallic minerals and rocks took place, including the following: coal from two mines at Spitzbergen, graphite, calcite and limestone (underground and opencast mining), magnesite, marble, talc, soapstone, feldspar, mica, quartz, quartzite, granites, syenites, slates, roof slates, etc. Mining of nepheline syenite is planned.

SWEDEN *By John Hedlund*

THE great demand for iron ore and the improved labour situation has resulted in increased preliminary work at Swedish iron ore mines, which during the last few years has been neglected. The year 1957 was also characterized by continued rationalization, new buildings, modernization, and plant extensions. During 1956 and 1957, 40 prospecting concessions for uranium were granted to 11 companies and individuals. In 1958, a considerably greater number of applications can be expected.

During 1957 iron ore output amounted to 20,035,000 tonnes, which is a record.

From October 1 the Swedish State has taken over the main part of LKAB (Loussavaara-Kiirrunavaara AB). Hence TGO's (Trafik AB Grängesberg-Oxelösund's) 54 years of activity at the Lappland mines have come to an end and Kiruna, Malmberget and Koskullskulle have become one administration unit, separated from TGO's mines in central Sweden, Grängesberg and Strassa.

At Malmberget, the new sorting plant was finished during the year, and construction was started of a new dressing plant which will have an annual output of 600,000 tonnes of iron ore concentrate. Four new shafts are planned and the sinter plant will be extended to an annual production capacity of 350,000 tonnes of pellets.

At Kiruna, work at the Central plant continues on the installation of additional machinery and shaft sinking, and extension of the ore stationyard to cover 18 tracks. The output of iron ore, estimated at 10,300,000 tonnes during 1958, will be 12,000,000 tonnes in 1962.

At Grängesberg, the sub-level caving is gradually being replaced by block caving. On the new transport level of 400 m. the ore is transported by Malmberg cars of 7 cu. m., which are emptied during the run, and in stoping operations the loading is carried out by LM100 loading machines feeding 2 cu. m. Granby cars.

At Strassa, where the annual output will amount to 430,000 tonnes of iron ore concentrate, the new shaft has come down to 80 m., at which depth connection was obtained with this level. Sinking will continue down to 150 m. A concrete shaft tower, 48 m. high, has been erected; it will be equipped with a koepe hoist for one skip and one passenger lift, both with counterweight.

Sorting and dressing plants have been projected and a new sinter plant is being planned, which will have an annual production of 150,000 tonnes of pellets.

At their mines in Kiruna, Tuolluvaara Gruv AB will increase their production in 1961 to 570,000 tonnes of iron ore, of which 140,000 tonnes are calculated to be concentrate.

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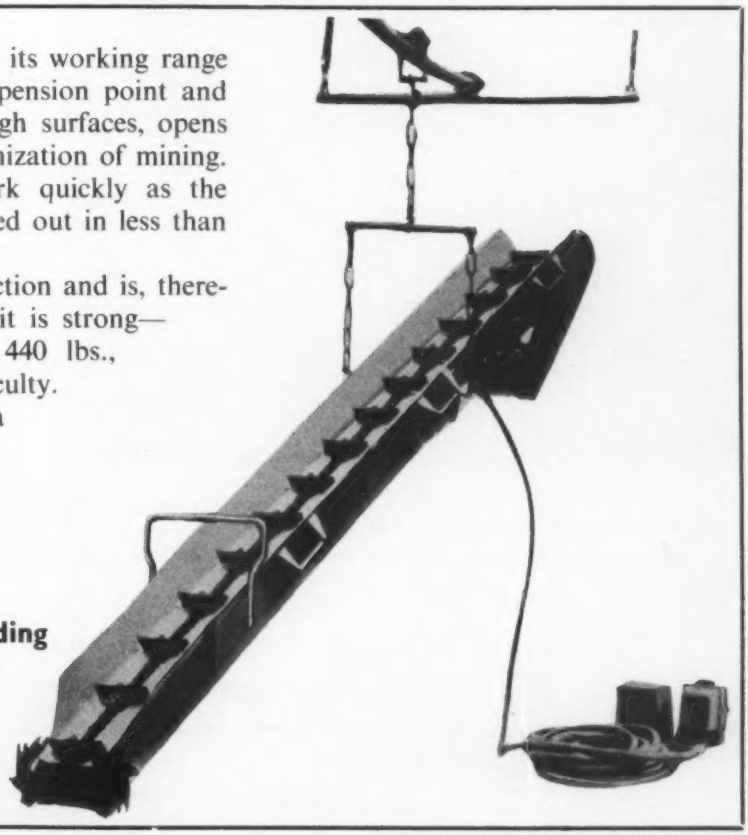

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Stora Kopparbergs Bergslags AB is building a new plant for iron ore concentrate at Grängesberg which is designed for an annual production of 300,000 tonnes.

At Tuna Hästberg, Bergslaget has sunk the shaft to the final depth of 550 m., and in the new shaft a tower koepe hoist for double skip and single passenger hauling is being installed.

At the Vintjärn field, a completely new plant with shaft and dressing plant is planned for an increased production of up to 100,000 tonnes of iron ore concentrate yearly. In the Haggruvan mine in the Ställberg field, Ställbergsbolagen has sunk a new passenger shaft to a depth of 500 m. and has started on a reorganization of the caving method in the Ställberg mine, which is being changed from shrinkage stoping to sub-level benching.

At the Polhem mine near Ställdalen, the company has completed a pilot plant, and at Utö in the archipelago of Stockholm investigations in the iron ore field are proceeding.

At Ickorrbotten and Källbotten near Ludvika, AB Statsgruvor has built new shaft towers. The new dressing plant at Haksberg, which is estimated to yield 250,000 tonnes of iron ore concentrate yearly, and which will have a flotation department for hematite ore, is scheduled to start at the beginning of 1958. The central shaft and the shafts at Ickorrbotten and Källbotten are being sunk to depths of 400, 325 and 300 m. respectively.

At Norberg, AB Statsgruvor has completed the new 65 m. high concrete shaft tower at the Mimer field, which will accommodate a koepe hoist for rock skip and a passenger lift, each with counterweight. At 275 m. and 800 m. depth transport levels are being made to provide for the transport of ore from the Prost and Stor mines to the new sorting and dressing plant at Mimer. The works will have an annual capacity of about 35,000 tonnes of lump ore and 140,000 tonnes of iron ore concentrate. The new plant is scheduled to start operation in 1960.

Norbergs Grufförvaltning is constructing a new sorting and dressing plant at Lake Balsjön at Norberg which is estimated to yield 250,000 tonnes of lump ore and 200,000 tonnes of iron ore concentrate yearly.

Surahammars Bruk has started its new crushing mill at the Kallmora mine in Norberg. The plant is designed to handle 250,000 tonnes of goods yearly, and plans are being made to build a dressing plant of suitable capacity.

Fagersta Bruk has started sinking a hoisting shaft at the Rud mine from 170 m. to 400 m. In an auxiliary shaft 75 m. has been sunk. In the Smältarmoss mine a new installation is being made to increase the annual output of iron ore concentrate.

In Dannemora, a new dressing plant for magnetite ore is in operation, its scheduled output being 25,000 tonnes yearly plus manganiferous iron ore from the sorting plant amounting to 235,000 tonnes yearly. The concentrate holds 60 per cent Fe and 1.5 per cent Mn.

Mining is in full swing at Vingesbacke, owned by SKF Hofors Bruk. The annual production is scheduled for 80,000-100,000 tonnes of iron ore concentrate.

At Bispberg, the ore in the Bispberg field, indicated on the surface by a magnetometric survey, has been investigated at a depth of 520 m., when it was found that there were two parallel orebodies. One of them, which was encountered at 440 m., has been followed in the field down to 500 m. and showed a width of 5.5 to 6.0 m. The other orebody was cut off on 520 m. through a displacement. Exploration is proceeding along with the development work on the big orebody.

In regard to sulphite ores, SGU found, during the year, that the iron pyrites deposit with copper and zinc at Stekenjokk in Norrbotten contained 4,000,000 tonnes.

The Boliden Co. reported that mining at Langselegruvan during the year was at a rate that is estimated to yield 200,000 tonnes of zinciferous pyrites ore yearly. The ore is transported by standard gauge railway underground to the central works at Boliden. The Akulla mine has been abandoned as exhausted.

At Kristineberg, a new shaft tower has been built at the new central shaft, and in the Adak district a pilot plant has been started at the Cu-deposit of the Brännmyra Mine. Laisvall lead ore mine has reached an annual production of 500,000 tonnes.

CHIEF MINERAL OUTPUTS

(in tonnes)

	1956	1957
Iron ore	19,075,000	**20,035,000**
Pyrite	489,119	**498,853**
Lead conc.	46,085	**50,722**
Zinc conc.	117,166	**118,720**
Copper conc.	69,232	**76,996**
Tungsten conc.*	450	**505**
Fluorspar	1,000	**2,600**

*60 per cent WO_3

DENMARK

GREENLAND'S mineral resources attracted increasing attention during 1957, the search for radioactive ores being stimulated by the completion of Denmark's first reactor, a Zero energy reactor from the U.S.A., which was set in operation on August 15.

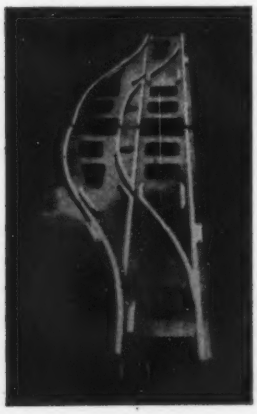
A team of over 40 geologists and chemists has been sent to Greenland to explore the mineral wealth of the area, especially uranium. A preliminary study of the area around Marssaqa on the Skov Fjord shows a fairly high uranium concentration, which may be worth exploitation. Serious prospecting for uranium began only two years ago, although the existence of radioactive ore in east Greenland was reported as early as 1948. In addition to uranium, the exploration group has been studying deposits of gold, silver, lead, graphite, marble, coal, oil and iron.

Dr. C. Jacobsen, head of the chemical laboratory of the Riso Atomic Research Station, stated that extraction of uranium and thorium from Greenland ores was impossible by present methods. The laboratory is endeavouring to find an economic method of extraction, in co-operation with the Cryolite Co., Oresund, but several years' work may be required.

An offer by a U.S. mining company to invest up to $40,000,000 in the exploration of molybdenum deposits in East Greenland was turned down by the Danish Government, which decided to provide capital itself for investigation and possible development of the deposits.

During the first year's operations the Mestersvig mines in Greenland shipped 13,650 tonnes of zinc concentrates and 8,750 tonnes of lead concentrates to purchasers in West Germany and Belgium. The year's total output was some 22,000 tonnes. Under normal weather conditions the mines can operate for 10 months a year.

Production of brown lignite increased so much during 1957 that it was expected to reach the record figure of 3,000,000 tonnes. The three largest electric power stations in Southern Jutland alone take a daily quantity of between 600 and 1,500 tonnes.



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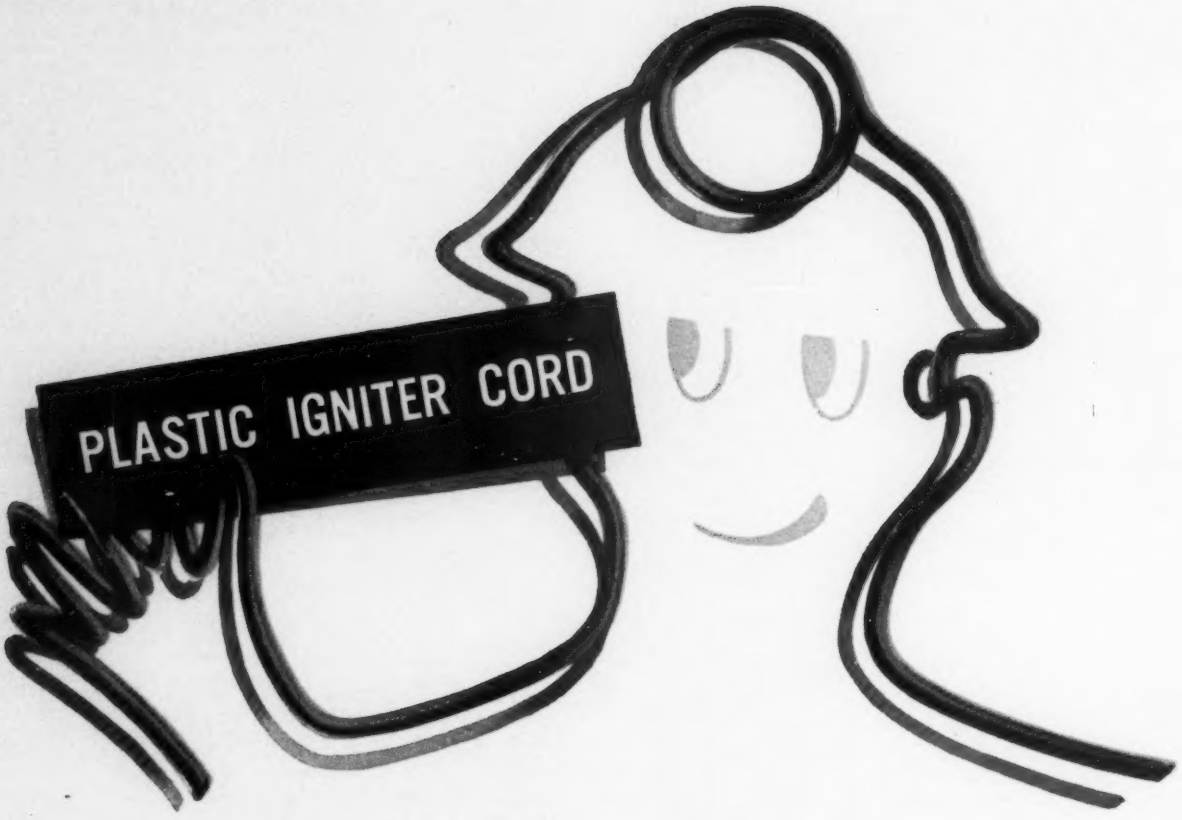

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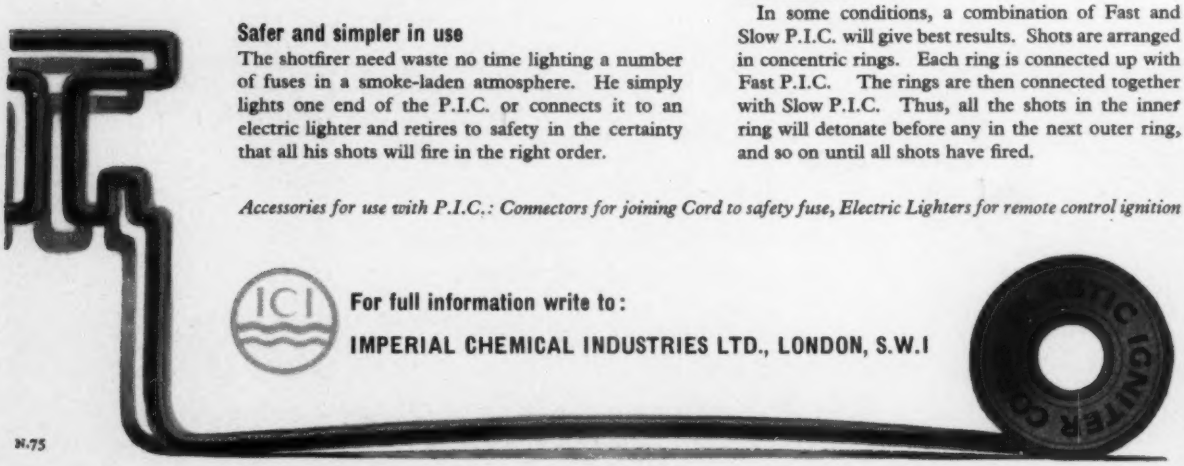

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Progress Report on the Mines

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A Chill Wind from Wall Street

BASE METAL SHARES HIT: GOLDS SHOW PROMISE

By A Special Correspondent

THE dominating feature of mining share markets during 1957-58 was the continued downtrend here and on Wall Street in base-metal issues. This could hardly have been wondered at in view of the emergence of the U.S. recession and the consequent setback in metal prices during the period. Tin fell from £775 a ton in April 1957 to £730 in the following April and would almost certainly have fallen further if it were not for the buying from the Buffer Stock manager at the support level of £730 a ton. Lead tumbled from £111 to £72 and zinc from £98 to £62. Copper continued its catastrophic fall from the all-time peak of £437 in March 1956, declining in 1957-58 from £245 to £160 before rallying to around £175 per ton.

Copper share prices were thus particularly severely hit over the period under review. In the early part of 1958 a steady stream of sharply reduced company earnings and interim dividends coupled with the first rumblings of the growing U.S. recession, accelerated the fall in share prices.

Recently, however, share prices, taking their cue from a firm Wall Street have made a strong recovery. At the same time the metal quotation has been relatively steady around £180 a ton and it is generally felt that the metal price has bottomed.

Bancroft and Kansanshi

There were two major casualties in the copper share market during the year and each could offer speculative possibilities on a revival in the metal price.

The first and possibly most disastrous, from a share market angle, was Bancroft. This young Northern Rhodesian copper proposition ran into serious underground troubles in the shape of mud and water at a time when the copper price was falling steadily and an operational loss of £1,250,000 was incurred on its initial production.

Accordingly the shares tumbled from 50s. 3d. to only 10s. 6d. Subsequently the shares recovered to around 15s. How much further they recover depends largely on the copper price, but it has to be borne in mind that technical troubles apart, the company will have a very heavy capital structure to carry once production is resumed.

The other casualty was the Kansanshi mine, in which Rhodesia-Katanga holds a 32 per cent interest. A bigger stake is held by Anglo American Corporation who also act as the consulting engineers. For years past Kansanshi had been beset by various troubles—mostly technical—but last year it seemed that at last the worst was over. Then in October a break-through of water underground engulfed the mine's pumping system. Despite efforts to control the deluge, the mine gradually filled. Finally, workers were laid off and the mine was placed on a care and maintenance basis. Rhodesia-Katanga shares which had been up to 54s. 3d. in early 1957, had fallen with the rest of the market to around 20s. before the disaster occurred. After the news they dropped to around 7s. 6d. At the time of writing they have recovered to 12s. The cost and practicability of dewatering the mine is not thought to be insurmountable, but it is unlikely that any move in that direction will be made while copper remains at its present low level. Furthermore, the treatment problems of Kansashi's difficult oxidized ore are yet to be finally overcome; a solution appears to have been found, but has yet to be put into operation. There is no heavy capital structure—as in the case of Bancroft—and given a recovery in copper the mine will probably be reopened. On this basis, Rhodesia-Katanga shares offer speculative possibilities.

O.T.C. Benefits

An important event during the period under review for many other mining shares was the advent of Overseas Trading Corporation concessions. Unlike coppers, many of the tin and lead-zinc producers are London Registered and thus stand to benefit substantially from the concessions. Broadly speaking, O.T.C. status means that an overseas operating company, registered in the U.K. will no longer have its profits mulcted by U.K. tax (less double tax relief) in addition to the foreign taxes deducted in the country where operations are carried out. The only U.K. tax payable will be income tax on dividends distributed here.

Tins Ride the Storm

Tin companies which had been experiencing one of the most prosperous times in their history encountered a less happy state of affairs following the introduction of the International Tin Agreement. The scheme aimed at stabilizing the price of tin between limits of £730 and £880 a ton for which purpose a buffer stock was founded comprised of cash and metal so that the buffer stock manager could use the cash to buy metal when the price fell below the £730 floor level and conversely sell metal at the ceiling of £880. The companies did not find it too burdensome to provide the manager with these resources to begin with, but later when it became obvious that tin was going to need a great deal of support at £730 the situation became more difficult. A second contribution for the buffer stock manager was called and in addition the imposition of severe production quotas—varying with each mine but often meaning a cutback of as much as 50 per cent—added to the producers' difficulties. The effect of all this is now beginning to be reflected in dividends and profits, but even so, tin share prices have not lost so much ground as other base-metal producers. This is largely because most companies are fairly well placed to ride out the present difficult times.

Tin is unique in that unlike other metals, there has been practically no discovery of new deposits made since the war. Present reserves of tin-bearing land are being gradually worked out and they are not being replaced. Only the U.S. recession has resulted in the need for the buffer stock manager to support the market. This recession cannot last for ever and any real revival of tin consumption in the U.S. will have an immediate effect on the metal price.

Holders of reasonably "long-life" tin mine shares may well feel justified in holding on despite the present difficult times.

The outlook for lead-zinc producers is not nearly so clear cut and it seems that only a sustained recovery in the U.S. economic position can alter the present gloomy situation. Over the past year share prices have steadily fallen in tune with metal prices and company earnings. Tentative proposals to increase U.S. tariffs and possibly to restrict imports there as well, may benefit U.S. mines but can only make things worse for foreign producers.

Among the more striking falls in share prices during 1957-58 was that of Consolidated Zinc. The shares dropped from a peak of 92s. 6d. to 42s. 9d. and things were not helped by the discovery that because of its complicated spread of operations, O.T.C. benefits would not apply in this case. Particularly sad was the slump in Lake George from 13s. 6d. to only 2s. 6d.

Platinums Flounder

After a period of almost uninterrupted expansion, the Rustenburg group of platinum mines encountered a serious falling off in demand for their metal. The change from under to over supply in platinum was underlined in August 1957 when Baker Platinum cut its price from £34 to £31 per ounce. The oil industry, it was found, had satisfied its major requirements and, furthermore, as a result of new refining processes was likely to use less metal in the future. Cheap offerings of Soviet metal and currency switching operations via Kuwait were other bearish factors.

Rustenburg abandoned its current expansion programme and as the situation worsened was forced later to cut production by 40 per cent. Potgeitersrust, Waterval and Union Platinums, whose incomes stem from shareholdings in Rustenburg were obliged to follow suit when Rustenburg subsequently omitted its interim dividend.

Synthetic Diamonds

Diamonds also felt the draught from Wall Street, although sales of stones continued to rise during part of 1957 to new peaks. The December quarter, however, showed a falling off and this trend was accelerated in the March quarter of 1958. Experiments made by G.E.C. of

America resulted in synthetic industrial stones of up to 1/10 ct. being produced. A pilot plant turned out these stones and sold them to industry at nearly twice the cost of the natural product. This represented the first commercial attempt to compete in the market with synthetics and gave rise to many fears as to what might develop in the future.

More Hope for Golds

During 1957-58, the gold share market seemed to be entirely frustrated. Elsewhere in the Stock Exchange the deterioration in the U.S. economic climate was being felt in no uncertain manner, but despite the steady fall in industrial and base metal share values nobody seemed keen to venture into gold shares. The gold mines themselves with a fixed price and guaranteed market for their product continued in the main to do well and the monthly returns recorded this progress. The newer mines, in particular, returned with almost monotonous regularity new profit peaks month after month.

At the same time many convincing arguments for a higher gold price were heard and even the most pessimistic of observers admitted that the chances of an upward adjustment here were better than they had ever been. Several boomlets were sparked off—most of them being based on gold price hopes—but although business revived with each upturn in prices, interest just as suddenly petered out again.

Many reasons were given for the poor response to the possibilities of this market, but few of them seemed to be very convincing. Perhaps the biggest stumbling block was the ingrained fear of South African politics and the accompanying racial problems which always worry outside observers more than the South Africans themselves. The South African general election passed off far more smoothly than had been thought likely here. The increased Nationalist majority at the elections was taken here to be a rather vague bear point for the market, but few had really expected a return of the United party. Even fewer for that matter, could say just what difference, exactly, a return of the United Party would have made to the picture anyway.

So there it was. Business remained for the most part at a minimum and it seemed that share prices were far more likely to wilt on lack of interest than to rise with the fortunes of the mines themselves.

Strangely enough, like many things seen from too close a distance, the day by day view was very misleading. The simple fact was that a drastic change in the market had come about almost without anybody noticing it at the time.

What had happened was that the overall downtrend that had persisted for many years past had quite indisputably been reversed. On April 26, 1957, the Financial Times Gold Share Index stood at 65.6. On April 25, 1958, it was 73.4. The movement in itself was not large, but it did show the change in trend of the market. Significantly, in recent weeks prices have held their ground firmly even though business has stayed small.

The outlook shows promise, gold shares are beginning to return to brokers' lists of recommendations and the steady flight away from the dollar into gold has reached almost alarming proportions. Nobody can say when the gold price will be raised, but sooner or later it seems that a re-adjustment must take place. In the meantime, there are many sound gold shares that pay generously for their keep. Western Holdings, Saint Helena, Buffelsfontein and Blyvoor are just a few of the many shares in this category.

Mention of gold shares would not be complete without reference to the West African mines. After some earlier apprehension, the inauguration of Ghana has taken place remarkably smoothly and confidence is expressed in the outlook for foreign capital there. The Ashanti mine made great strides over the past 12 months and with its new shaft now in commission looks likely to do even better. O.T.C. benefits will also apply and the mine should provide a promising investment over the next few years.

LONDON STOCK EXCHANGE

HIGH AND LOW PRICES REACHED BY LEADING MINING SHARES—

JANUARY 1, 1957 to APRIL 4, 1958

Finance	High	Low
African & European	63/9	51/3
Anglo American Corpn.	6⅛	5⅛
Anglo-French	26/3	20/9
Anglo-TransvaalConsol.	30/6	26/3
Central Mining (£1 shrs.)	75/-	51/3
Consolidated G'fields	64/4½	44/6
Consol. Mines Selection	34/-	25/6
East Rands Consols	2/-	1/3
General Mining	84/6	50/-
H.E. Prop.	9/7½	7/4½
Johnnies	56/9	37/9
Rand Mines	73/9	61/3
Rand Selection	37/6	31/10½
Union Corporation	43/9	33/3
Vereeniging Estates	5⅛	4⅛
Writs	47/3	33/6
West Wits.	40/9	29/9
Rand Gold		
Blyvoors	23/6	18/6
Brakpan	6/3	4/-
Buffelsfontein	40/-	29/6
City Deep	15/-	10/9
Consol. Main Reef	15/3	10/6
Crown	32/6	17/6
Daggas	38/-	23/10½
Dominion Reefs	18/3	12/6
Doornfontein	26/3	19/9
Durban Deep	29/6	20/-
E. Champs	4/-	2/-
E. Daggas	9/3	6/10½
E. Geduld (4s. units)	30/-	20/-
E. Rand Props.	48/9	36/6
Geduld	85/-	53/9
Govt. Areas	3/10½	2/4½
Grootvlei	19/4½	13/6
Hartebeestfontein	61/6	44/6
Libanon	8/3	6/-
Luipards Vlei	14/6	9/-
Marievale	19/7½	15/10½
New Kleinfontein	4/4½	3/-
New Pioneer	29/9	16/-
Randfontein	36/-	22/6
Robinson Deep	9/-	6/-
Rose Deep	11/9	6/1½
Simmer & Jack	4/4½	3/4½
S. A. Lands	25/-	18/3
Springs	2/7½	1/6
Stilfontein	39/6	25/-
Sub Nigel	20/9	10/10½
Vaal Reefs	41/4½	28/6
Van Dyk	4/3	1/3
Venterspost	15/3	11/3
Vlakfontein	16/6	13/6
Vogelstruisbult	14/7½	8/6
West Driefontein	5 5/8	4 3/8

Rand Gold contd.	High	Low
W. Rand Consolidated	34/6	21/9
Western Reefs	31/6	24/-
O.F.S Gold		
Freddies	7/3	4/-
Freddies Consolidated	5/-	2/6
F.S. Geduld	83/9	56/9
Geoffries	3/6	2/7½
Harmony	34/3	18/3
Loraine	5/4½	1/10½
Lydenburg Estates	16/3	9/9
Merriespruit	5/-	3/-
Middle Wits	13/6	7/3
Ofsits	62/6	44/6
President Brand	56/9	45/-
President Steyn	32/6	23/9
St. Helena	42/-	21/3
Virginia	10/7½	7/4½
Welkom	17/6	12/3
Western Holdings	93/9	58/-
West African Gold		
Amalgamated Banket	1/6	-/10½
Ariston	4/9	3/4½
Ashanti	16/3	9/4½
Bibiani	2/10½	1/10½
Bremang	1/9	1/3
Ghana Main Reef	1/10½	1/4½
Konongo	2/1½	1/3
Western Selection	6/10½	4/-
Australian Gold		
Gold Mines of Kalgoorlie	14/3	8/7½
Great Boulder Prop.	14/3	11/7½
Lake View & Star	22/3	17/3
Mount Morgan	17/3	6/9
North Kalgurli	8/3	6/6
Sons of Gwalia	3/9	1/9
Western Mining	11/9	7/9
Miscellaneous Gold		
Cam & Motor	8/7½	7/7½
Falcon Mines	8/-	6/9
Globe & Phoenix	27/-	21/9
Motapa	1/6	6¼d
St. John d'El Rey	86/10½	25/-
Zams	58/-	39/9

Diamonds and Platinum	High	Low
Anglo American Inv.	10	7
Casts	14/9	10/-
Cons.Dia.of S.W.A.Pref.	11/3	9/9
De Beers Defd. Regd.	5⅛	4⅛
De Beers Pfd. Regd.	14⅛	12⅛
Pots Platinum	17/-	3/9
Waterval	28/-	6/-
Copper		
Bancroft	50/3	10/6
Chartered	79/3	42/6
Esperanza	3/4½	1/-
Magundi	13/6	1/3
Messina	9⅛	3⅛
Nchanga	13⅛	8
Rhod. Anglo-American	5⅛	2⅛
Rhod. Katanga	54/3	7/6
Rhodesian Selection	24/9	12/9
Rhokana	42⅛	20
Rio Tinto	5⅛	2⅛
Roan Antelope	15/4½	6/10½
Selection Trust	5⅛	2⅛
Tanks	88/9	42/6
Tharsis Sulphur Regd.	93/9	57/6
Tin (Eastern)		
Ayer Hitam	32/6	19/6
Gopeng	16/6	9/4½
Hongkong	8/7½	4/4½
Ipoh	19/-	11/-
Kamunting	13/1½	7/7½
Kepong Dredging	6/3	2/10½
Kinta Tin Mines	29/-	15/-
Malayan Dredging	18/1½	9/4½
Pahang	8/-	3/10½
Pengkalen	16/9	9/3
Petaling	8/3	3/6
Rambutan	29/6	12/6
Siamese Tin	16/7½	7/-
Southern Kinta	22/9	15/6
S. Malayan	12/9	8/3
S. Tronoh	12/4½	6/6
Sungei Kinta	22/9	15/3
Tekka Taiping	9/10½	6/6
Tronoh	14/9	7/10½
Tin (Nigerian and Miscellaneous)		
Amalgamated Tin	11/3	5/-
Beralt Tin	55/3	24/6
Bisichi	5/6	3/1½
British Tin Inv.	26/6	14/6
Ex-Lands Nigeria	2/9	1/7½
Geevor Tin	21/1½	14/9

Tin (Nigerian and Miscellaneous) contd.	High	Low
Gold & Base Metal	1/7½	-/9
Jantar Nigeria	4/9	1/9
Jos Tin Area	16/3	13/3
Kaduna Prospectors	2/3	1/3
Kaduna Syndicate	2/7½	1/10½
London Tin	13/-	6/6
United Tin	1/-	-/4½
Silver, Lead, Zinc		
Broken Hill South	78/9	56/3
Burma Mines	4/4½	1/7½
Consol. Zinc	92/6	42/9
Lake George	13/6	2/6
Mount Isa	28/3	20/-
New Broken Hill	58/-	30/-
North Broken Hill	6⅛	3 11/16
Rhodesia Broken Hill	14/3	6/6
San Francisco Mines	31/6	14/6
Uruwira	5/3	-/9
Miscellaneous Base Metals and Coal		
Amal. Collieries of S.A.	60/-	50/9
Associated Manganese	43/9	29/-
Cape Asbestos	12/9	9/-
C.P. Manganese	30/3	20/3
Consol. Murchison	53/-	18/9
Natal Navigation	75/-	61/6
Turner & Newall	73/6	51/-
Wankie	19/3	13/6
Witbank Colliery	5⅛	4 11/16
Canadian Mines		
Dome	$27	$24
Hollinger	$73	$36
International Nickel	$222	$130
MiningCorpn. of Canada	7 11/16	4⅛
Noranda	$112	$69⅛
Yukon	6/9	3/10½
Oil		
British Petroleum	8 11/16	4
Apex	68/6	1/3
Attock	42/3	23/9
Burmah	6	2 11/16
Canadian Eagle(Br.)	97/3	39/6
Mexican Eagle	20/-	15/9
Shell	10 11/16	5⅛
T.P.D.	7 7/16	2 11/16
Ultramar	5⅛	2 7/16

The Consolidated Gold Fields of South Africa, Ltd.

THE accounts of Consolidated Gold Fields of South Africa for the year to June 30, 1957, were an impressive reminder of the breadth and strength of the company's interests which are held through its wholly owned subsidiary, New Consolidated Gold Fields. These interests lie mainly in South Africa where its gold mining investments are very largely confined to the rich new mines on the Far West Rand and in the Orange Free State which have not yet reached full production. But a substantial stake is also held in mining ventures in other parts of Africa, in Australia and in the Americas. In terms of metals these interests consist mainly of gold, gold-uranium platinum, and base metals. There is, too, an interest in oil undertakings.

While the advantage of a broadly-based portfolio is the measure of security it provides, this has meant in the case of Gold Fields that while its income from gold-mining investments has shown a rising trend, it has had to share to some extent in the general set-back which has occurred in the profitability of platinum and base metal mining. However, the American business recession which is the main cause, will not persist indefinitely, and the long-term view calls for continued search for and development of new sources of raw materials. This affords opportunities for the larger mining finance companies with the necessary technical knowledge, not only to maintain the value of their investment portfolio, but also to expand.

In this fundamentally important respect Gold Fields has an enviable record. In fact, it was in pursuance of these aims that the company at the end of June, 1957, issued 979,202 ordinary shares of £1 each at £2 per share and £1,958,404 6 per cent Convertible Unsecured Loan Stock 1977-82 at par. The net proceeds of the issue amounted to some £3,790,000, part of which is required to meet future capital expenditure involved in bringing to production the Saaiplaas gold mine in the Orange Free State, part for the company's participation in the development of an ultra deep mining project in the Far West Rand, and the remainder to support its general exploration programme.

Accordingly, Gold Fields issued capital now consists of 1,750,000 6 per cent 1st Preference Shares of £1 each; 1,250,000 6 per cent 2nd Preference Shares of £1 each; and 5,875,212 Ordinary Shares of £1 each, a total issued capital of £8,875,212. A further 783,362 Ordinary Shares of £1 each are reserved for the conversion rights attaching to the 6 per cent Loan Stock. Each £100 of stock may be converted into 40 Ordinary Shares during 1958, at a conversion price of 50s. per share; or 39 Ordinary Shares during 1959; or 37 during 1960; or 35 during 1961, at a conversion price of 57s. 1½d. per Ordinary Share. The Stock, unless previously converted, or unless purchased or repaid as provided in the terms of issue, is finally repayable at par plus accrued interest on December 31, 1982.

At June 30, 1957, the consolidated balance sheet, which embraces all the interests of the Group, disclosed fixed assets with a book value of £1,192,000 after deducting accumulated depreciation of £880,000; investments with a total book value of £14,603,000 of which £12,799,000 was represented by quoted investments have a stock exchange value at that date of £24,807,000; and net current assets of some £2,778,000. This latter figure was struck, however, before the introduction of the new funds arising from the issue which should ensure the maintenance of a strong liquid position.

Taking the quoted investments at market value and other assets at book figures at June 30, 1957, and after allowing for the preference capital and the proceeds of the new issue, the net asset value per ordinary share on the increased capital is approximately 96s.

The Consolidated profit and loss account for the year ended June 30, 1957, showed a net profit, after taxation, of £2,273,000, an increase of £677,000 over the 1955-56 results. It must be borne in mind that net earnings were swelled by the sale of the company's holding in the Trinidad Oil Co. which was largely responsible for profits from the realization of investments rising by £559,000 to £740,000. Even so, income from dividends and interest on investments at £2,201,000 reflected an improvement of £300,000 and topped the £2,000,000 mark for the first time.

In a circular dated June 28, 1957, issued in connection with the share and loan stock issue referred to earlier, it was stated that the company's investments in terms of value could be classified as to 55 per cent gold, 19 per cent platinum, 15 per cent base metals, and 11 per cent representing other interests. The depressed state of the platinum and base metal industries over the past year means that income from investments in these categories must inevitably be lower, but this may be offset to some extent by increasing revenue from gold investments. However it is unlikely that Gold Fields profits for the year ended June 30, 1958, will match those for the year under review.

ESTABLISHED PRODUCERS ON THE EAST AND CENTRAL RAND

The seven established gold mining companies administered by Gold Fields on the Rand include some of the oldest companies still operating in this field, and two uranium producers, Vogelstruisbult and Luipaards Vlei.

Vogelstruisbult began milling only 21 years ago but during the last four years there has been a general lowering of percentage payability and values which has led to a weakened ore reserve position. Working profits from gold have also declined and from their peak level of £1,343,965 in 1955 dropped to £652,950 last year. On the other hand, earnings from uranium have risen steadily since 1954 and in 1957 totalled £634,980. This figure must, however, bear loan interest and repayment charges and after their deduction, uranium earnings represent just over a third of the total profits. Scope for development within known pay shoots is limited and exploratory work accomplished so far has not revealed any values of economic significance.

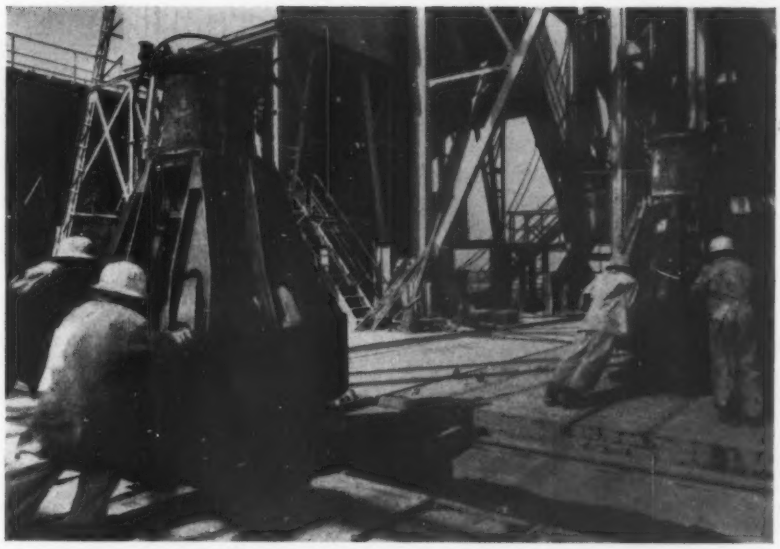
Luipaard's Vlei has the distinction of being one of the richest of the South African uranium producers, with a uranium recovery grade averaging around 1.2 lb. per ton. All but a small part of the operating profit of

FINANCIAL RESULTS

(for the last two complete financial years)

COMPANY (Year to Dec. 31 except where otherwise noted)	*ORDINARY SHARES IN ISSUE*	*PROFIT AND LOSS RESULTS £(000)*								*Capital Expenditure £(000)**		*DIVIDENDS PER SHARE*			
		Working Profit		*Uranium Profit*		*Taxation and/or Mining Lease*		*Net Profit After Tax*				*Paid*			
												1957		1956	
		1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	*Fin. s. d.*	*Int. s. d.*	*Fin. s. d.*	*Int. s. d.*
Doornfontein† ...	9,828,000 (10/-)	1,852·1	1,067·8	97·0	—	—	—	1,809·5	955·3	846·7	953·1	1 0	6	—	—
Libanon†	7,937,300 (10/-)	677·6	675·6	—	—	—	—	644·9	652·7	426·0	471·3		3½		3½
Luipaards Vlei†...	4,969,105 (2/-)	120·4	234·4	941·3	642·0	227·1	16·1	751·8	767·9	63·8	70·6	1 1	1 0		10½
Rietfontein Cons. .	1,122,252 (5/-)	197·3	215·5	—	—	82·1	89·7	118·1	124·0	—	2·8	1 1	1 1	1 1	1 1
Robinson Deep ..	2,000,000 (7/6)	126·8	67·4	—	—	—	—	162·4	82·9	Cr.10·9	48·4		9		6	6	3
Simmer	6,750,000 (2/6)	237·0	191·2	—	—	30·9	11·2	259·0	229·8	Cr.12·7	184·2		5		5	5	5
Sub Nigel†	1,771,875 (10/-)	506·5	902·3	—	—	186·1	376·6	321·7	540·0	4·1	518·7	1 6	1 9	2 4½	2 4½
Venterspost†	4,900,000 (10/-)	810·0	898·0	—	—	131·6	196·0	678·4	663·4	147·9	94·2		10½		10½	10½	10½
Vlakfontein	6,000,000 (10/-)	1,033·1	974·5	—	—	412·5	422·6	648·3	530·1	1·0	91·4		11		10	10	9
Vogels	5,028,571 (10/-)	653·0	1,010·7	635·0	607·0	396·1	488·1	842·2	1,034·6	7·8	13·8	1 2	1 4	1 6	1 8
W. Drie†	7,041,080 (10/-)	7,011·1	5,690·9	313·0	—	2,700·2	1,951·5	4,524·5	3,616·2	2,658·9	1,783·6	3 6	3 3	3 0	3 0
Doornfontein	Results for the six months ended Dec., 1957	1,099·4	815·7	83·2	15·2	—	—	1,192·0	834·5	306·8	409·8	—	—	—	—
Libanon		319·5	328·0	—	—	—	—	326·6	334·8	206·4	215·3	—	—	—	—
Luipaards Vlei ...		5·9	61·9	363·0	225·5	152·1	101·6	221·5	191·3	17·8	29·1	—	—	—	—
Sub Nigel		170·8	322·9	—	—	63·6	127·7	120·9	201·9	23·4	2·4	—	—	—	—
Venterspost		341·7	405·6	—	—	76·7	76·0	273·7	339·3	52·2	77·3	—	—	—	—
W. Drie		3,551·5	3,461·1	107·8	16·3	1,346·9	1,296·8	2,333·0	2,148·1	1,445·1	870·1	—	—	—	—

†Year to June 30.



Cactus-type grabs, seen at the No. 1 Shaft of Free State Saaiplaas G. M. Co. Ltd.

this company is earned in the uranium section where gold is recovered as a by-product. Accordingly, the outlook for this mine depends, to a great extent, on the position of the uranium market after the company's contract with the South African Atomic Energy Board expires seven years hence.

Valkfontein crushes ore yielding over 7 dwt. gold per ton, which is high for a mine in the East Rand. Milling began in 1942 and with the recent completion of a programme of expansion, dividends have shown a rising trend. Results in the largely undeveloped western area of the mine continue to be satisfactory and a long life for the mine is assured. The company also has valuable freehold property.

East of Vlakfontein lies the Sub Nigel mine, which began milling in 1909. This mine is now fully developed and the remaining ore reserve is being steadily depleted, but is being supplemented by ore of lower grade made available from exploratory stoping and from surface dumps of ore. The mine must be regarded as in the latter stages of its life with the outlook of steadily diminishing operating profits. The company has an important shareholding in the neighbouring Vlakfontein Co.

In the Central Rand, Robinson Deep, which began milling in 1898, is now mainly dependent on the development of ore in the western half of the mine, between 8,500 ft. and 9,100 ft. below surface, where the long-wall method of stoping is being adopted. This company also owns certain valuable freehold property in the Johannesburg area.

The Rietfontein mine, with its small area of 374 claims, began milling in 1935. The mine is fully developed and the ore reserve is showing a progressive decline as the remaining widely-dispersed blocks are successively worked out. The opportunities for mining ore in areas outside the ore reserve blocks are becoming restricted, and the life of the mine is likely to be short.

Simmer and Jack, the oldest mine in the Group, began crushing in 1898. The rise in working costs over recent years has made operations in many of the deeper parts of the mine uneconomic and work is being confined to the remaining better grade blocks of ore. The company owns valuable freehold property in the Germiston area.

WEST WITS LINE

Gold Fields has a substantial interest in the West Wits line—an area extending over a distance of some 36 miles, including the Libanon and Venterspost mines at the eastern end and the West Driefontein, Blyvooruitzicht and Doornfontein mines towards the west.

Venterspost, which began milling in 1939, draws its ore from the medium grade Main Reef and from the Ventersdorp Contact Reef which contains zones of high gold enrichment. Adjoining this mine to the south is the Libanon mine, which began milling 10 years later and which recently has started mining the Ventersdorp Contact Reef in addition to the Main Reef, on which operations were confined in the first years of its life. A programme in which both these mines are concerned, for opening up the faulted zone near their common boundary has shown encouraging values, and a third sub vertical shaft system is being sunk by the Venterspost Co. to exploit the southern portion of its mining area.

The Libanon mine is also engaged in an extensive shaft sinking programme, the main feature of which is the sinking of a third surface vertical shaft in the southern sector of its lease area, where encouraging results have been obtained in underground development.

Both these mines would benefit substantially from an increase in the price of gold.

The other two mines on the West Wits line administered by Gold Fields are West Driefontein and Doornfontein, both of which treat the tailings from their gold plants for the recovery of uranium.

Doornfontein is the younger of the two having begun milling in 1953, a year later than West Driefontein. The mine is sited immediately west of Blyvoor and the rich Carbon Leader being worked is giving relatively high values and payability averaging over 90 per cent. Mining to date has been concentrated in the eastern half of the property which is served by two shafts. The present monthly milling rate is in the order of 90,000 tons. As at West Driefontein

DEVELOPMENT AND MILLING RESULTS

(for the last two complete financial years)

COMPANY (Year to Dec. 31 except where otherwise noted)	TOTAL ORE RESERVES As at last report		DEVELOPMENT RESULTS						MILL THROUGHPUT													
			Ft. Sampled (000)		Payability				Tonnage				Gold Recovered						Working Profit			
					%		Av. Value (In.-dwt.)		Milled (000)		Cost per Ton		Ounces (000)		Grade (dwt./ton)		Cost per ounce		Per ton		Per oz.	
	Tons (000)	Value (dwt.)	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956
Doornfontein† ...	1,956	7·4	19·2	16·0	91	93	512	394	931	663	61/8	68/8	375·1	266·6	8·1	8·0	153/1	170/10	39/9	31/10	98/9	79/3
Libanon†	2,463	4·7	17·3	13·1	71	71	290	284	1,185	1,177	45/2	43/4	265·8	257·0	4·5	4·4	201/2	198/4	11/5	11/3	51/-	51/7
Luipaards Vlei*†..	1,628	4·4	22·2	20·4	68	67	218	249	971	1,043	42/9	41/8	173·9	191·4	3·6	3·7	238/7	226/11	2/6	4/3	13/10	23/4
Rietfontein Cons.†	194	5·1	6·1	8·2	47	43	421	429	290	309	45/1	43/3	67·8	70·0	4·7	4·5	193/4	190/3	13/7	13/9	58/3	60/4
Robinson	1,338	4·5	7·5	5·8	39	52	352	341	908	916	49/-	49/6	187·3	185·5	4·1	4·1	237/9	244/8	2/10	1/2	13/7	5/11
Simmer	994	4·2	24·2	24·0	40	52	292	306	1,151	1,208	46/9	41/3	213·9	213·0	3·7	3·5	229/2	233/10	4/1	2/11	22/2	16/8
Sub Nigel†	833	7·7	26·3	28·6	23	24	327	365	796	796	56/1	55/5	217·3	247·1	5·5	6·2	205/6	178/1	12/9	22/5	46/7	73/-
Venterspost†	2,263	5·4	34·7	31·0	59	60	437	328	1,497	1,456	49/1	47/1	355·3	344·7	4·7	4·7	206/9	198/11	10/1	12/2	45/7	51/3
Vlakfontein	1,566	8·1	29·6	28·0	47	42	384	395	593	544	54/10	54/4	211·8	195·1	7·1	7·2	153/7	151/6	34/10	35/5	97/6	98/10
Vogels	2,321	5·3	40·6	38·8	28	27	272	264	1,185	1,203	58/3	45/4	273·6	295·9	4·6	4·9	204/8	184/4	11/-	16/6	47/9	67/1
W. Drie†	2,080	16·8	21·3	20·8	100	100	801	859	900	852	81/5	75/3	847·9	708·8	18·8	16·6	86/5	90/6	156/3	132/11	165/10	159/9
Doornfontein	Results for the six months ended Dec., 1957		12·9	9·7	90	90	430	549	512	446	60/7	63/5	211·6	177·6	8·3	8·0	146/5	159/4	42/11	36/10	103/11	91/10
Libanon			11·6	8·5	66	78	263	286	616	580	45/7	45/-	137·8	129·8	4·5	4·5	204/5	201/2	10/4	11/4	46/4	50/6
Luipaards Vlei ...			10·5	12·7	70	67	237	222	440	499	44/4	42/8	78·4	89·6	3·6	3·6	248/11	237/9	3d	2/6	1/6	13/10
Sub Nigel			11·8	16·2	24	16	323	306	400	400	54/8	55/11	101·0	114·7	5·1	5·7	216/4	194/11	8/7	16/2	33/10	56/4
Venterspost			20·0	17·1	60	66	424	513	735	743	51/-	48/11	177·0	176·7	4·8	4·8	211/11	205/10	9/3	10/11	38/8	45/11
W. Drie			8·2	11·2	100	100	663	821	450	450	82/3	81/2	431·5	419·9	19·2	18·7	85/9	87/-	157/10	153/10	164/8	164/11

*Main reef section only. †Year to June 30.

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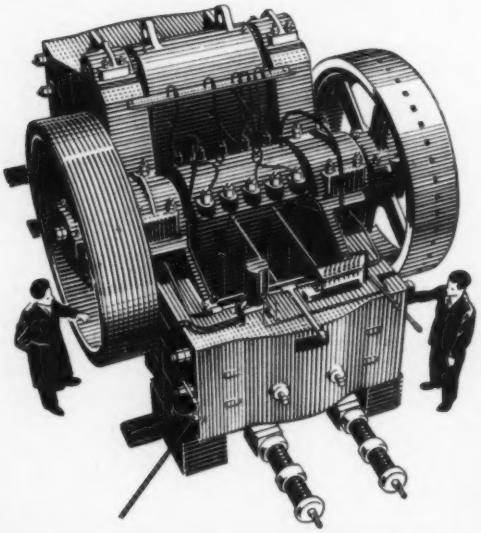

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URANIUM PRODUCTION 1957

COMPANY (Year to June 30 unless otherwise noted)	ORE RESERVES		DEVELOPMENT			PRODUCTION			
	Tons	Grade	Ft. Sampled	% Payable	Value	Tons Treated	Grade	Gross Profit	Rate of redemption of loan
	(000)	(lb./ton)	(000)		(in./lb.)	(000)	(lb./ton)	(£000)	(£000 p.a.)
Doornfontein ..	1,956	0·21	19·2	91	12·5	309	0·23	97·0	22·4
Luipaards Vlei.... (Bird reef section)	733	1·20	20·8	59	90·2	552	1·30	941·3	354·0
Vogels†	998	0·51	15·1	30	18·9	534	0·43	635·0	288·0
West Drie.....	2,080	0·23	—	100	10·6	339	0·26	313·0	230·0

†Year to Dec. 31, 1957

extensive mechanical sorting masks the fact that the tonnage mined is more than twice the amount crushed. Earnings are currently running close to 5s. per share annually, but capital expenditure continues to be heavy. The mine paid a maiden dividend of 6d. per share in June, 1957, which was doubled to 1s. in December and the Chairman has stated that shareholders may continue to look for higher dividends. The value of the company's uranium is not important and the grade is below average. Ore reserves continue to build up satisfactorily and the outlook for this long life mine must be considered bright.

West Driefontein, with its 100 per cent payability, its milling grade of over 19 dwt. per ton, and working profits in 1957 the equivalent of over 20s. per share, is generally considered to be one of the most interesting and attractive gold mining investments is South Africa. Three shafts have been completed, a fourth—the No. 5—is in course of sinking, and a fifth shaft is the scene of periodical sinking operations. Thus ample provision is being made for opening up the large mine area of 7,010 acres which is underlain in its entirety by the Carbon Leader Reef which shows exceptional richness in the western sectors of the mine. The Main Reef is also present and with the Ventersdorp Contact Reef, which covers about half the property, may yield limited tonnages to supplement ore from the Carbon Leader. All this points to some future increase in the present milling rate of 75,000 tons a month in due course though with the high degree of mechanical sorting of reef carried out at the mine, it is necessary to hoist over 150,000 tons per month to maintain the present milling rate. The heavy shaft sinking programme is cutting into available earnings but dividends have steadily increased. During the year ended June 30, 1957, dividends totalled 6s. 3d. per share, while the Government received the equivalent of 7s. 8d. per share in taxation and lease payments. A further 6s. 6d. per share was absorbed by capital expenditure.

Uranium production started in 1956 and the plant, which is shared jointly with Doornfontein, has a monthly capacity of 80,000 tons. Uranium values are only moderate and profits from this source are useful but not significant. The company has certain rights to subscribe for shares in Western Deep Levels Ltd., which was formed during 1957 to mine a large area to the south of the West Driefontein and adjoining Blyvooruitzicht mining base areas.

Apart from Gold Fields' direct interest in the five mines on the West Wits line it has an indirect interest through its investment in West Witwatersrand Areas. This company started life as an exploration company but is now firmly established as a major mining finance company. In addition to its shareholdings, given in the table below, the company owns the entire share capital of Carletonville Estates Ltd. which continues to develop the main residential and business centre for the mining community of the Far West Rand.

FREE STATE SAAIPLAAS

Although Gold Fields has taken a less active part in developing the Orange Free State than some of the other South African mining houses, it has direct share interests in three O.F.S. companies in the Anglo American Corporation group, namely, Free State Geduld, Western Holdings, and Welkom details of which companies are to be found on page 256; in St. Helena in the Union Corporation group (see page 264); and in Harmony in the Central Mining group whose progress over the past year is to be found on page 260. Gold Fields has a further large interest in Harmony through its holding in New Consolidated Free State Exploration Co. This company was formed by Gold Fields in 1944 to examine areas under option and carry out drilling. Through its interest in the farm La Riviera No. 289 the company received a participation in Harmony. NCFSE also carried out the original drilling programme in the Saaiplaas area and has a substantial holding in the Saaiplaas Co.

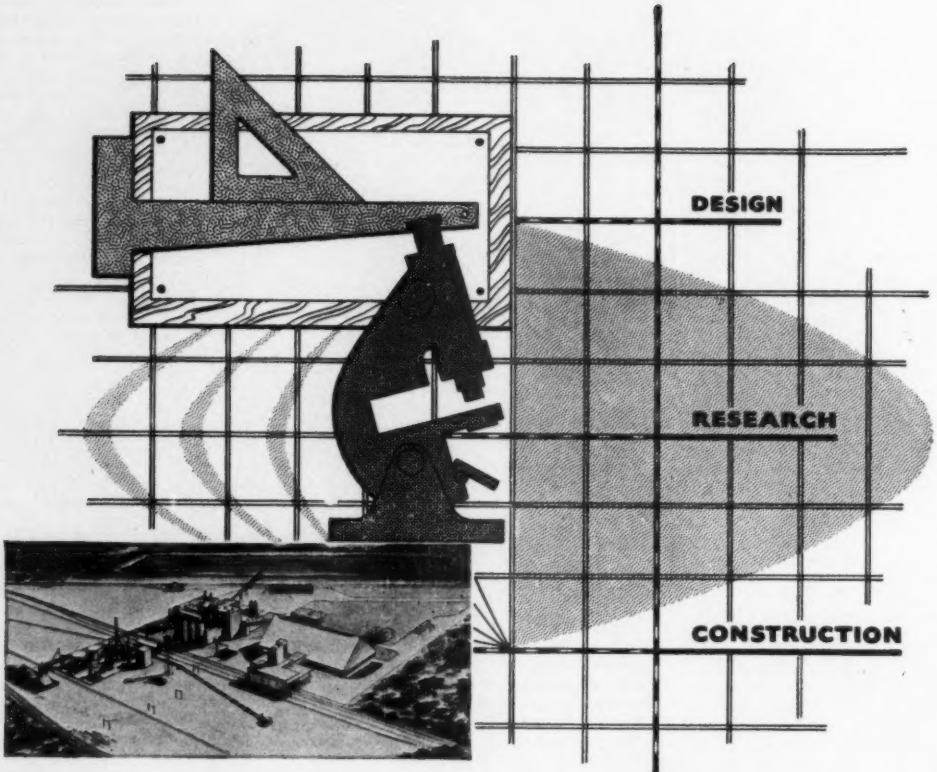
Free State Saaiplaas, Gold Fields first Orange Free State gold mine was formed in 1955 and it is hoped to bring it into production by the summer of 1960. Two shafts are being sunk in the south-eastern part of the mine. Full scale sinking operations at No. 1 shaft began in January, 1957, and by April 30, 1958, this 24 ft. circular ventilation shaft had reached a depth of 5,137 ft. Its final depth will be about 5,700 ft. Earlier in the month this shaft cut the "A" reef horizon at a depth of 4,925 ft. and it is expected that the Basal reef will be intersected at a depth of around 5,375 ft. It is expected that the Basal reef should be intersected late this month or early in June.

Full scale sinking of the No. 2 shaft. which has an internal diameter of 27½ ft, and is the largest in South Africa, began in September, 1957, and by April 30, 1958, had reached a depth of 4,028 ft. This shaft is to be sunk to a depth of about 6,500 ft. It was at this shaft that sinking during the month of September, 1957, advanced no less than 834 ft. in 30 days—a world record in shaft sinking for all types and sizes of shafts. The magnitude of this achievement may be further gauged by the fact that 51,900 tons of rock were broken and hoisted during this 30 day period. There could be no better proof of the excellence of the equipment and methods employed by the Technical Advisers or of the competence of the management.

Until underground development has been accomplished it is impossible to make any reasonable assessment of the mine. But boreholes indicate that the richest part of the mine is in the southern portion nearest to Harmony.

It is hoped to bring the mine into production in July, 1960, at an initial milling rate of 50,000 tons a month, rising to 75,000 tons after the first six months and to a 100,000

Winders at No. 2 Shaft, Free State Saaiplaas Gold Mining Company Limited



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tons after a further year. The consulting engineers state that the Basal Reef in the Saaiplaas lease area is potentially an economic source of uranium.

The initial issued capital was £6,067,559 divided into shares of 10s. each. Last month (i.e. April), however, plans were announced by which a further £4,854,046 would be raised. This involves the offer to shareholders registered on May 6, 1958, of one combined unit, comprising one convertible note of 10s. and three shares of 10s. each, for every five shares held at a price of £2 per combined unit. The notes carry interest at 6½ per cent per annum and will be convertible into shares between September 2 next and June 30, 1961, in the ratio of two shares for three notes. The offer has been underwritten and the latest date for exercising rights is June 10, 1958.

Gold Fields has a large stake in Rustenburg Platinum Mines, the world's largest producer of platinum metals, through Waterval (Rustenburg) Platinum and Union Platinum which are administered by Gold Fields and which have interests of about 42 per cent and 18 per cent respectively in the Rustenburg Co. The platinum market turned decidedly weak last year owing partly to technological advances in the oil industry which reduced the demand for platinum used as a catalyst in the platforming process, and partly to heavy offerings at what might be termed a cut price from the U.S.S.R. As a result it has been decided not to use the plant capacity made available by the recent expansion programme at Rustenburg until demand for platinum warrants the additional production.

Elsewhere in the Union the company has an interest in Vierfontein Colliery which supplies the local Electricity Supply Commission Power Station, chiefly responsible for supplying the requirements of the Orange Free State goldfield. Other interests include an associated engineering company, C. C. Taylor & Co. (Pty.) Ltd., which is engaged in the development and manufacture of plant and machines for mechanized handling of ore underground. A comparatively recent acquisition was a large holding in the South-West Africa Co. for which Gold Fields, in concert with Anglo American Corporation and the British South Africa Co., made a successful take-over bid. SWACO holds a Special Grant of prospecting and mineral rights in the richly mineralized Otavi mountainland and also a holding of 95,000 shares in the rich Tsumeb mine.

In the Americas, the group's interests are largely handled by Gold Fields American Development, a mining finance company with its own portfolio of investments and subsidiary operating companies. This wholly owned subsidiary includes amongst its investments a holding in The Fresnillo Co., operating lead-zinc-silver mines in Mexico, the entire share capitals of Tri-State Zinc Inc., operating zinc-lead mines in Virginia and Illinois, and the Buell Engineering Co. which specializes in the provision of plant for the collection of industrial dusts. In the oil industry there are holdings in Apex (Trinidad) and in Ultramar.

Australian interests are mainly confined to Lake George Mining Corporation and Lake View and Star both of which are administered by Gold Fields.

Lake George is working a complex orebody yielding lead-zinc-copper-gold-and-silver but the fall in base metal prices has adversely affected results. In view of the trend of the known orebodies to diminish in depth, an accelerated programme of development and exploration has been put in hand.

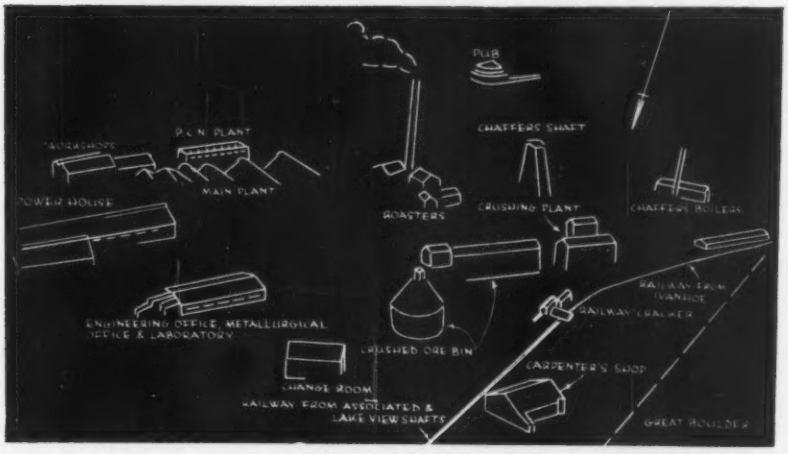
Lake View and Star is the largest undertaking operating on Western Australia's famous Golden Mile. Since its formation in 1910 the company has greatly extended its property and has established a strong technical position. Operations continue to be successful, development is giving satisfactory results, and the modernization of equipment underground has accelerated the opening up of the orebody.

During the year to June 30, 1957, the company was advised that it qualified as an Overseas Trading Corporation. As an O.T.C. the company will obtain substantial tax benefits, and accordingly, the Board has withdrawn its application to transfer its domicile to Australia.

During the year ended June 30, 1957, profit, before tax, amounted to £419,000 which was slightly less than in the previous year. The company's inclusion as an O.T.C. enabled it to write back tax provisions no longer required amounting to £158,000. This enabled the allocation to reserves to rise to £170,000 against £100,000 and to increase the total dividend distribution to 2s. 6d. per share compared with 2s. per share in the preceding year.

The company's exploration activities in various parts of the world are continuing. While the search is being directed mainly toward the discovery of new deposits of base metals in common use, examination has also been made of mineral deposits containing lesser known metals, demand for which is expected to increase for modern industrial purposes. On its own account and in participation with other companies, Gold Fields is investigating extensive areas in the Federation of Rhodesia and Nyasaland and geological investigation is also proceeding in parts of Tanganyika. Much the same comment applies to Canada where New Consolidated Canadian Exploration Ltd. ("Newconex"), a wholly owned subsidiary of Gold Fields American Development Co,. completed its first full year of operations in 1957 during which time it examined a large number of mining propositions. In certain cases options were acquired and preliminary field work has been undertaken. In Australia, the newly formed New Consolidated Gold Fields (Australasia) Pty. Ltd., has been active and during 1957 acquired an interest in Mining Corporation (Aust.) N.L. which owns a block of ground to the south of the Mount Isa mine in Queensland, and a programme of deep drilling is being undertaken.

The surface workings of Chaffers Shaft, Lake View & Star Ltd.



Anglo American Corporation of South Africa, Ltd.

FORMED in 1917 when the other major Rand finance houses were already firmly established Anglo American Corporation of South Africa, thanks to the initiative, courage and foresight of the late Sir Ernest Oppenheimer, has risen through vicissitudes that in the early 1930's saw the price of its shares fall as low as 2s. 6d., to the forefront of the South African mining industry.

As will be readily appreciated when it is mentioned that the Corporation's total assets at December 31, 1956, were valued at almost £125,000,000, Anglo American has played the leading part in the tremendous expansion of mining in Southern Africa in the post war years. Its achievements in the past decade are an impressive memorial to one of the greatest financiers the world has ever known, and it is fitting that these achievements should be briefly reviewed.

The post war expansion of the Corporation's mining business demanded that most of its preoccupations in this decade should be with the financial, administrative and technical organization of an immense programme of new enterprises.

In the gold mining industry, no fewer than seven large new mines were brought to production and the Corporation was also administratively and technically responsible for the construction of five uranium extraction plants and two sulphuric acid plants. The coal department opened, developed and equipped six new collieries and carried out two major extensions to existing collieries—it planned and installed a £2,000,000 coking plant at the Vryheid Coronation Colliery; and, in Southern Rhodesia, re-equipped the Wankie Colliery, thereby increasing production capacity from 2,750,000 tons to 5,000,000 tons per annum.

During the same period, the Corporation, as consulting engineers to the De Beers group of companies, planned and supervised the re-opening and complete re-equipment of the New Jagersfontein & Premier diamond mines; initiated modern mining methods in the old Kimberley diamond mines; and organized and provided new plant and equipment for the substantial expansion of operations of Consolidated Diamond Mines of South-West Africa, raising the output of diamonds from 163,611 ct. in 1946 to 969,984 ct. in 1956.

In Northern Rhodesia its technical departments were responsible for planning and supervising the expansion of output at Nchanga from some 17,000 l.tons in 1946 to more than 114,000 l.tons in 1956; and at Rhokana copper production rose from 69,166 l.tons in 1946 to 81,566 l.tons in 1956. Furthermore, the large new copper mine, Bancroft, was brought to production and although this has unfortunately coincided with a period of low metal prices, and development has been complicated by the presence of excessive quantities of water, the mine will in due time take its place as one of the major world producers. These developments in the Copperbelt have included extensions to the thermal power stations and the installation of major plants, among them an extensive leach plant at Nchanga, and an intricate cobalt extraction plant at Rhokana.

IMPRESSIVE DEVELOPMENTS

All these impressive mining developments have demanded much ancillary effort in the planning and supervision of new townships and extensions to existing townships; the provision of hospitals; and even the building of a bridge at the mouth of the Orange River. And research and administrative facilities have of necessity also been greatly expanded to keep pace with these many developments and all that they entail at these levels. Sir Ernest indeed had every justification for saying in his Chairman's statement of June, 1957:—"When I look back on the Corporation's work in the past 10 years, I feel proud of the immense contribution we have been able to make to the post-war development not only of the Union but also of the Federation of Rhodesia and Nyasaland."

No less remarkable has been the part played by the Anglo American Corporation and its associates in finding the finance for these and many associated developments in which the Group's interests did not amount to control. This task was aggravated by economic and political conditions which, for the most part, did little to attract investment capital to Southern Africa. Yet the Corporation and its associates have been responsible for introducing an aggregate amount approaching £200,000,000 in financing these vast mining and ancilliary developments. This has been achieved by a variety of means not the least of which has been the introduction of both local and overseas institutional capital into the mining industry through a series of loan issues either by the leading financial companies of the Group or under their guarantee, and carrying conversion rights as an alternative to normal redemption. That this may mark a turning point in the provision of finance for new mining enterprises was foreshadowed by Sir Ernest last year when, after reviewing the difficulties encountered in the past decade in assuring adequate finance, and pointing to the fact that as precious and base minerals will increasingly be found to lie at greater depths beneath the earth's surface their exploitation will involve higher expenditure and will be subject to greater risks, he suggested that the mining industry was confronted with a new situation and a new challenge. Although there were great possibilities for arranging finance within the existing Group structures, no industry could be expected to be entirely self-financing.

In his view, the mining industry was entitled to look increasingly for support to the financial institutions, the traditional investment agencies of the general public. The accumulation of private funds in such institutions has reached immense proportions and bearing in mind existing trends in the United Kingdom, in Canada and in the U.S.A. there was no good reason why similar institutions in Southern Africa should not devote a proportion of their funds to so-called risk ventures. The growth of large mining Corporations with substantial spreads of interests and of mining investment trust companies with varied portfolios of mining shares, would, he suggested, in itself come to provide suitable channels for the investment of institutional

FINANCIAL RESULTS
(for the last two complete financial years)

COMPANY (Year to Dec. 31 except where otherwise noted)	ORDINARY SHARES IN ISSUE	PROFIT AND LOSS RESULTS £(000)								Capital Expenditure £(000)		DIVIDENDS PER SHARE			
		Working Profit		Uranium Profit		Taxation and/or Mining Lease		Operational Surplus				Paid			
												1957		1956	
		1957	1956	1957	1956	1957	1956	1957	1957	1957	1956	Fin. s. d.	Int. s. d.	Fin. s. d.	Int. s. d.
Brakpan	4,600,000 (5/-)	181·8	165·8	—	—	20·7	23.5	270·6	239·3	142·9	8·6	4½	4½	6	4½
Dagga*	7,000,000 (5/-)	3,247·3	3,377·0	1,779·2	1,653·1	2,730·6	2,625·8	5,041·9	5,016·8	60·0	110.6	2 9	2 6	2 9	2 9
E. Dagga	3,730,000 (10/-)	413·8	404·2	—	—	163·4	152·7	433·2	419·0	5·6	4·3	9	9	9	9
F. S. Geduld*†	10,000,000 (5/-)	2,254·1	410·9	—	—	—	—	1,819·4	106·3	518·1	1,919·8	1 0	—	—	—
Loraine*†	16,453,372 (10/-)	Dr.66·2	Dr. 252·9	319·9	—	—	—	221·5	Dr. 339·3	536·1	813·3	—	—	—	—
P. Brand*†	13,000,000 (5/-)	4,807·4	4,259·9	479·7	397·0	—	—	5,246·0	4,612·5	1,846·0	1,434·7	2 6	2 6	2 0	1 6
P. Steyn*†	13,000,000 (5/-)	2,408·4	2,293·1	744·2	692·8	—	—	2,848·8	2,661·4	452·6	637·9	1 6	1 3	1 0	9
S.A. Lands	2,475,000 (3/6)	725·7	812·0	—	—	257·3	367·0	746·0	836·5	45·8	538·9	1 6	1 6	1 6	1 6
Springs	10,110,000 (5/-)	—	125·0	—	—	—	15·3	—	145·7	45·8	Cr.54·7	—	—	3	2½
Vaal Reefs*	10,000,000 (5/-)	1,979·4	750·4	1,413·6	436·3	—	—	3,234·4	1,134·0	1,281·8	356·9	2 3	1 3	1 0	—
Welkom*†	12,250,000 (5/-)	641·7	424·3	317·8	—	—	—	652·0	261·4	1,399·3	1,213·3	3	—	—	—
Western Hldgs.*†	7,496,000 (5/-)	3,726·9	2,302·4	—	—	—	—	3,768·0	2,226·1	1,797·2	1,312·0	3 0	2 0	2 0	1 6
Western Reefs	7,000,000 (5/-)	807·1	615·1	1,861·6	1,710·1	992·0	559·5	2,579·3	2,202·4	45·2	102·1	1 3	1 3	1 3	1 3
F. S. Geduld*†	Results for the three months to December, 1957	923·0	286·2	—	—	—	—	923·0	286·2	518·8	225·0	—	—	—	—
Loraine*†		L38·2	L23·5	54·7	22·6	—	—	16·5	L0·9	85·0	123·6	—	—	—	—
P. Brand*†		1,251·9	1,145·1	89·2	69·0	—	—	1,321·1	1,231·6	340·7	276·2	—	—	—	—
P. Steyn*†		570·4	600·7	110·8	104·5	—	—	681·2	705·2	44·2	61·2	—	—	—	—
Welkom*†		189·8	136·0	99·1	—	—	—	288·9	140·7	221·4	225·4	—	—	—	—
Western Hldgs.*†		1,095·5	760·2	—	—	—	—	1,095·5	760·2	372·9	352·9	—	—	—	—

*Scheduled uranium producer. †Year ends September 30.

funds. That the Corporation has long been aware of this revolution in the investment field is clearly shown by its success in providing finance for so many ventures in the difficult years of the past decade.

INVESTMENTS AND ACTIVITIES

Following the established practice of the "group system," Anglo American has substantial direct and indirect holdings in the companies it directs and manages, but in virtually no case does its direct stake amount to anything like a majority interest. It is also directly and indirectly interested in a number of ventures not falling under its administration. Its principal interests are as follows.

Although the Corporation is still interested in a number of the older Witwatersrand mines, its investments in the new mines of the Orange Free State and Far West Rand must to-day account for fully 80 per cent of its gold investments. The gold mining industry in turn may well constitute more than 50 per cent of the total investments. A large proportion of this stake is probably held, directly and indirectly, through Orange Free State Investment Trust, and West Rand Investment Trust, both of which are major financial holding companies in their own right although subsidiary to Anglo American within the group structure. The gold investments are dealt with in greater detail later in this review.

The diamond interests perhaps rank equally in importance with the stake in copper and are held through the medium of Anglo American Investment Trust. The Trust in turn holds over 20 per cent of the equity of De Beers Consolidated Mines, and almost 18 per cent of the capital of the Diamond Corporation as well as substantial stakes in the diamond purchasing and trading companies of the De Beers group. Its investment in De Beers has been steadily increased in the post-war years by the purchase of additional shares. The large investment in Diamond Corporation is of particular interest in that this company, although controlled by De Beers, holds the major stake in De Beers Investment Trust Ltd. which, with capital funds of the order of £40,000,000 at its disposal, has channelled its investments into gold, industry and other non-diamond mining enterprises.

De Beers Consolidated's direct and indirect stake in this Investment Trust amounts to approximately 84.5 per cent in all so that Anglo American Investment Trust as a result of its direct stake in Diamond Corporation as well as in De Beers, is particularly interested in the stabilizing influence which the steady growth of De Beers Investment Trust is likely to have on the results of this large group of diamond companies. (See also De Beers Consolidated Mines Ltd., page 258.)

The copper interests are held largely through the medium of Rhodesian Anglo American Ltd., which, directly, and indirectly through Rhokana Corporation, holds 52½ per cent of the equity of Rhokana, some 39 per cent of Nchanga, 25 per cent of Bancroft, 17⅛ per cent of Mufulira and almost 14 per cent of the Chibuluma issue, as well as less important investments in Wankie Colliery, Rhodesia Broken Hill and Tanganyika Concessions. Its affairs are reviewed on page 292.

COAL INTERESTS

The investments in coal are held through African and European Investment Co. and Vereeniging Estates. Collieries under the control of the group sold over 14,000,000 tons of coal, representing over 40 per cent of the total Union coal sales during 1956. The Corporation's stake in coal was greatly increased during 1957 as a result of its acquisition of 2,568,056 additional shares in African and European Investment which increased its holding from approximately 25 per cent to over 86 per cent of the equity. There is an ever-growing demand for coal in South Africa, but nevertheless adequate cope for exports when the present deficiency of rail transport is overcome. It is expected that this position will be reached during 1960. As pithead prices are of the order of 11s. per ton in the Transvaal and 17s. per ton in Natal, South African coal should be well placed from the competitive point of view when coal consumption in Europe revives once again. There are moreover a number of alternative markets which the industry will no doubt explore when transport problems are a thing of the past. During the year ended December 31, 1957, African and European made £1,305,643 after tax, and Vereeniging Estates £1,139,370 after tax, both figures subject to audit.

The Corporation is also directly and indirectly interested in Wankie Colliery (see page 295), the Federation's only coal mine.

The essence of the group system is to provide financial, management and technical services on a scale and of a quality which few single enterprises could afford. The provision of such services is to-day a major occupation of the financial companies which control the various groups and particularly so with Anglo American which, in addition to providing the usual services for the gold mining companies directly under its wing, also acts in one or more of these capacities for enterprises controlled by associated companies. In this field it acts as technical consultant to the copper mines and interests of Rhodesian Anglo American; to the diamond mines of the De Beers group; and the collieries of African and European, Vereeniging Estates and Wankie. In addition, the management and secretarial services of such major financial companies as African and European, Rand Selection, West Rand Investment Trust and Orange Free State Investment Trust are entrusted to the Corporation. As will be readily appreciated, the provision of such services results in a material contribution to revenue and is in effect a hidden "asset" for which provision should be made when considering the intrinsic value of the shares.

FINANCIAL

The issued capital of Anglo American Corporation which stood at 7,835,342 ordinary shares of 10s. each fully paid, and £2,379,375, 6 per cent cumulative preferred stock at December 31, 1956, was increased during 1957, and early 1958, firstly by the issue of 783,534 ordinary shares flowing from the capitalization of £391,767 of the Corporations' reserves; and secondly by the issue of 1,284,028 ordinary shares as a result of the offer to shareholders of African and European Investment Co. Ltd., under which 2,568,056 ordinary shares in the latter company were acquired. The Corporation and a wholly owned subsidiary now hold over 86 per cent of the equity of African and European, which thereby becomes a subsidiary. It was stated in a circular in connection with this offer in December, 1957, that the consolidated net assets of the two companies would aggregate about £80,000,000. Coincidental with this offer,

DEVELOPMENT AND MILLING RESULTS
(for the last two complete financial years)

COMPANY (Year to Dec. 31 except where otherwise noted)	TOTAL ORE RESERVES		DEVELOPMENT RESULTS						MILL THROUGHPUT													
			Ft. Sampled (000)		Payability %		Tonnage: Av. Value (In-dwt.)		Tonnage: Milled (000)		Tonnage: Cost per Ton		Gold Recovered: Ounces (000)		Gold Recovered: Grade (dwt./ton)		Gold Recovered: Cost per ounce		Working Profit: Per ton		Working Profit: Per oz.	
	Tons (000)	Value (dwt.)	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956
Brakpan	2,367	5·0	37·1	45·1	28	27	728	671	1,354	1,284	38/4	40/2	220·8	218·4	3·3	3·4	235/-	236/3	2/8	2/2	16/5	15/5
Dagga*	10,246	5·4	25·7	25·6	23	29	329	381	2,718	2,637	30/10	31/2	591·4	595·1	4·4	4·5	141/9	137/9	23/11	25/8	109/10	113/10
East Dagga	4,686	4·4	24·4	25·8	38	30	500	376	1,128	1,139	34/4	34/2	187·0	187·3	3·3	3·3	207/3	207/8	7/4	7/3	44/3	43/11
F. S. Geduld*†	1,899	18·7	12·2	11·1	99	97	1,347	1,194	1,899	352	78/4	70/4	380·1	132·8	11·8	7·5	133/1	186/8	69/9	24/3	118/8	64/4
Loraine*†	1,044	4·2	35·3	34·5	27	32	384	465	756	566	50/10	52/11	147·5	99·1	3·9	3·5	260/9	302/4	L1/9	L8/11	L8/11	L51/2
P. Brand*†	3,043	17·6	9·0	17·8	90	92	1,199	1,176	764	652	65/10	66/11	581·4	512·7	15·2	15·7	86/6	85/2	125/9	130/8	165/4	166/2
P. Steyn*†-	3,927	8·8	24·0	19·9	70	65	528	536	1,098	1,048	52/9	50/7	420·6	393·8	7·7	7·5	137/7	134/8	43/10	43/9	114/6	116/6
S.A. Lands	3,643	5·6	22·7	31·5	36	33	450	393	1,072	1,071	39/1	38/3	224·5	227·5	4·2	4·2	186/8	180/1	13/6	15/1	64/8	70/1
Springs	1,965	4·3	—	14·7	—	22	—	369	—	1,513	—	28/6	—	182·1	—	2·4	—	237/1	—	1/9	—	14/4
Vaal Reefs*	1,813	10·0	24·6	18·1	76	88	537	629	750	401	58/9	56/9	333·3	151·2	8·9	7·5	132/3	150/8	52/9	37/9	118/9	100/-
Welkom*†	3,471	6·5	13·3	20·9	70	85	410	434	1,024	1,015	53/6	47/8	267·8	225·8	5·2	4·4	204/5	214/5	12/6	8/3	47/11	37/2
Western Hldgs.*†	3,930	14·0	19·2	14·3	90	87	1,240	961	1,144	932	53/3	51/11	538·0	376·5	9·4	8·1	113/4	128/6	65/2	49/6	138/7	122/8
Western Reefs*	4,546	5·9	40·3	40·5	48	52	508	460	1,440	1,447	44/6	42/7	319·3	294·5	4·4	4·1	200/11	209/2	11/2	8/8	50/6	42/4
F. S. Geduld*†	Results for the three months to Dec., 1957		3·9	3·0	93	100	1,153	1,482	190	139	79/4	76/1	134·3	64·8	14·1	9·3	112/2	163/2	97/2	41/2	112/3	88/4
Loraine*†			6·1	8·0	23	30	357	389	184	180	53/1	50/6	36·1	34·3	3·9	3·8	270/6	264/11	L4/2	L2/7	L21/2	L13/8
P. Brand*†			3·7	2·2	92	94	1,168	1,554	208	180	67/9	66/5	156·6	138·9	15·1	15·4	89/9	86/4	120/8	126/11	159/10	164/10
P. Steyn*†			4·5	6·2	67	60	496	553	277	263	54/-	52/1	105·6	102·3	7·6	7·8	141/8	133/10	41/2	45/8	108/-	117/5
Welkom*†			3·2	2·9	75	73	470	434	242	255	59/1	51/5	72·4	63·1	6·0	5·0	197/3	207/11	15/9	10/8	52/5	43/2
Western Hldgs.*†			3·7	5·0	92	92	1,169	1,045	293	264	53/3	54/6	150·3	117·8	10·3	8·9	103/9	121/11	74/9	57/8	145/9	129/1

*Scheduled uranium producer. †Year end Sept. 30. L indicates a loss.

Aerial view of the surface plant at President Brand.

the Corporation made an issue of £6,000,000 5¼ per cent registered unsecured convertible notes. These additional funds were raised to enable an active development policy to be continued. The Notes may be converted into ordinary shares at any time from February 24, 1958, until March 31, 1962, at the rate of 13 shares for every £100 nominal of Notes. If unconverted, the latest redemption date is March 31, 1982.

The net profits of the Corporation for the five years ended December 31, 1956, after provision for taxation and preference dividends have been as follows:—

Year to Dec. 31	*Profit* £000	*Ord. Dividend* £000	*per share* s.	d.
1952	2,872	2,059	6	0
1953	3,122	2,154	6	0
1954	3,885	2,742	7	0
1955	*4,905	2,742	7	0
1956	4,275	2,742	7	0

*Including a non-recurring item of investment income.

In the prospectus issued in connection with the offer of the 5¼ per cent Notes, it was stated that the estimated profits of the Corporation for the financial year to December 31, 1957, exceeded the profits for 1956. Substantial sums have been utilized in recent years for the writing down of investments but this phase may now be drawing towards a close. Income from the investments in copper must again be expected to decline in the current financial year, but conversely income on the gold mining investments may be expected to show a further marked improvement. The surplus arising on realization of investments has had a negligible bearing on profits in recent years.

THE ORANGE FREE STATE

Of all the massive ventures in Southern Africa since the war, the one which has perhaps attracted the greatest degree of world attention is the development of the new goldfield in the Orange Free State. This is scarcely surprising as it has been an episode of profound significance in South Africa's history. It has circulated new wealth through the country, it has attracted fresh capital from abroad, and it has strengthened South Africa's exchange position. It has increased the national income by many millions of pounds each year. Furthermore, the country's gold output should, as a result, remain approximately as high during the next 30 years as it has been at any time during the past 30 years. According to an estimate by the Government Mining Engineer's office the Orange Free State goldfield will eventually yield up to 350,000,000 f.oz. of gold, worth £4,344,000,000. The amount of indicated ore is from 600,000,000 tons to 700,000,000 tons on the 11 producing mines, or approximately 60,000,000 tons per mine. All this stems from the courage and initiative of the mining industry, supported by its shareholders, which ventured vast sums of money in one of the greatest industrial enterprises of modern times.

Of the 11 producing mines, seven of which are also uranium producers, six are administered by the Anglo American Corporation which directly and indirectly is also very substantially interested in two of the other producing mines—Harmony and St. Helena. It is estimated that more than £230,000,000 has been spent on capital development on the goldfield by private enterprise and by Government services. Of this sum the Anglo American Corporation Group has expended approximately £110,000,000. The investments in this field are held both directly, and indirectly, principally through the medium of Orange Free State Investment Trust which has substantial investment in all the leading mines worth at current market prices some £35,000,000. All these mines made marked progress during 1957, a notable feature being the substantial improvement in dividend declarations or declaration of maiden dividends by all the higher grade mines.

The improvement in mining company dividends is reflected in the increase in the Orange Free State Investment Trust's profit after taxation, from £743,000 in 1956 to £1,399,000 in 1957. This enabled the payment of dividends totalling 3s. per share compared with 1s. 6d. per share for 1956. There was a material improvement in profits at all the group mines with the exception of President Steyn which maintained the good results of the previous year. This was reflected in rising dividends, Brand paying 5s. compared with 3s. 6d. in 1956; Steyn 2s. 9d. (1s. 9d.); Western Holdings 5s. (3s. 6d.); and F.S. Geduld and Welkom, 1s. and 3d. respectively, these being maiden declarations. Interim declarations for the current financial year are unchanged for Brand and Steyn, but Western Holdings has declared 3s. compared with 2s. in 1957 and F.S. Geduld and Welkom have declared their first interims of 2s. and 3d. per share respectively.

Each of the mines with the exception of Loraine and Welkom disclosed a substantial improvement in the volume of the ore reserves at September 30, 1957. The gold content of the reserves at Western Holdings and F.S. Geduld also showed material improvements, and at both these mines development indications were particularly favourable—especially at the F.S. Geduld No. 1 shaft and Holdings No. 2 shaft, the new No. 3 shaft at the latter mine also giving a very promising result in the reef intersection of 3,264 in-dwt. (Despite the improvements at F.S. Geduld No. 1 shaft, the No. 2 shaft area remains that in which the really high values have been disclosed.) The outlook for Loraine remains doubtful but development at the other mines again disclosed favourable results. The start of uranium production at Welkom and Loraine led to a material improvement in profits at the former, and to the conversion of a working loss to a combined profit at the latter. At all mines with the exception of Loraine, new shafts are in course of sinking which will facilitate plans to increase output. A steady improvement in output at the leading mines is therefore to be expected over the next two to three years and this coupled with the prospect of steadily rising recovery grades at W. Holdings and F.S. Geduld, holds out the promise of a further material improvement in profits of the group's mines in the Orange Free State. As there is a similar outlook for Harmony (Central Mining) and St. Helena (Union Corps.), in which the Corporation is also substantially interested, the outlook for its Free State investments is indeed promising.

FAR WEST RAND

The Corporation, through its substantial investments in West Wits, has long been materially interested in the exploitation of the high grade mines in that area. In 1933, large scale prospecting of the Klerksdorp area was begun by the Corporation and this work led to the establishment of the Western Reefs mine in 1933 and was perhaps largely responsible for the major developments near Klerksdorp after the war. The investments in the West Wits Co. and its associated mines, and in the leading Klerksdorp mines are perhaps held largely through the medium of West Rand Investment Trust, a major financial company in its own right with investments currently worth about £25,000,000. The largest investments are in West Driefontein, Blyvooruitzicht and Doornfontein on the West Wits line; and in Hartebeestfontein, Buffelsfontein, Vaal Reefs, and Western Reefs of the Klerksdorp district. Of these, only Vaal Reefs and Western Reefs are administered by the

Corporation. It also has a major direct and indirect stake in the prospective Zandpan mine near Klerksdorp and, more important, in the new Western Deep Levels mine situated immediately to the south of Blyvooruitzicht and West Driefontein.

WESTERN DEEP LEVELS

Western Deep Levels, administered by Anglo American, is the country's most ambitious gold mining venture ever, the culmination of courageous planning and painstaking negotiations lasting about 15 years. Sir Ernest, whose perseverance and unshakeable confidence in the prospects of this area were so largely responsible for the early launching of this vast project, presided at the opening ceremony in July last.

The mining area is equivalent to almost 7,000 claims and the ultimate aim is to treat 200,000 tons per month. It is estimated that some £800,000,000 worth of gold will be produced during a life of about 60 years. Two reefs, the Ventersdorp Contact (an important source of tonnage at the nearby Libanon and Venterspost mines) and the Carbon Leader (the rich gold carrier at West Driefontein and Blyvoor) are to be worked. The workings will range from a depth of about 5,000 ft. on the shallower Contact reef horizon to an ultimate depth of some 12,500 ft. on the Carbon Leader horizon. It is the first mine whose technical layout has been planned specifically for mining gold bearing reefs ranging from 5,000 ft. to 12,000 ft. below the surface. Four different shaft systems, involving eight shafts from surface and eight second stage subvertical shafts, will be sunk to exploit the northern part of the property first. It is thought that some five or six years will elapse before the start of production. Borehole drilling has indicated that the major portion of the area is underlain by the Ventersdorp Contact reef and wholly underlain by the Carbon Leader reef, the gold content of which may be expected to approach the richness of that reef at West Driefontein and Blyvooruitzicht.

The new mine is being launched with the encouragement of the Union Government. A recent amendment to the income tax act allows for an addition to capital expenditure ranking for redemption of an amount equivalent to 5 per cent per annum compound interest for deep mines such as this. This is a material concession which may result in the saving of millions of pounds in taxation, and it is enhanced by a comparatively mild lease formula of $Y = 15 - \frac{90.}{X}$

It is estimated that the mine will require £20,000,000 in capital spread over six years. The financial arrangements already entered into assure the raising of rather more than half this figure. Of this amount, £850,000 has been raised by the issue of "A" shares of £1 each, and £5,000,000 through loan facilities provided by a Loan Syndicate consisting of Anglo American Corporation Central Mining, and Consolidated Gold Fields. Not earlier than two years after the date of the first advance under the loan facilities, the new company will increase its capital by the creation of an additional 4,750,000 "A" shares of £1 each and such shares are to be offered for subscription for cash, at par, and in set proportions to Central Mining Finance, West Driefontein, Blyvooruitzicht, West Wits, and Western Ultra Deep Levels and/or their nominees. Under-writing of the issue has been arranged. The "A" shares carry the preferent right to receive dividends totalling 10s. per share before any dividend is paid in respect of any other type of share.

LOAN SYNDICATE

In consideration for granting the loan, the Loan Syndicate has the right to subscribe for up to 5,000,000 "B" shares of £1 each at par, exercisable up to a date 12 months after the time when the "A" and "B" shares start to rank pari passu for dividend purposes. The proceeds of any such subscriptions will be used in repayment of the loan. Furthermore, it is intended that any additional share capital required by the new company will be raised by the issue of "B" shares. Of the first 5,600,000 such "B" shares, 50 per cent are to be offered to the Loan Syndicate, and 50 per cent to the holders of "A" shares pro rata to their holdings.

Anglo American, through its participation in the Loan Syndicate is assured of a substantial direct stake in this promising new mine. It also has substantial indirect interests through holdings in the participating companies and particularly through its investment in West Rand Investment Trust. The latter company also participated in the Loan Syndicate through its association with the Corporation, and its potential direct and indirect participation will in due course amount to up to about 15 per cent of the capital of the new mine if the procedure outlined above regarding capital issues is followed to its logical conclusion.

Progress at the established mines of the Far West Rand is clearly indicated by the rise in the profit after taxation of West Rand Investment Trust, from £995,000 in 1956 to £1,715,000 for 1957, thus enabling a 1s. increase in dividend declarations, to 3s. per share.

At Western Reefs, working profits both gold and uranium, increased materially during the year but as this was offset by rising taxation, there was no change in the dividend of 2s. 6d. per annum. As an increasing proportion of the ore is being drawn from the Vaal Reef which is richer in both uranium and gold than the Elsburg Reefs, working profits should continue to rise thus offsetting any further likely increase in taxation. At the neighbouring Vaal Reefs mine, profits from gold and uranium rose by almost £2,000,000 to approximately £3,000,000, enabling dividends to be increased from 1s. per share to 3s. 6d. per share. Plant capacity is to be extended from 65,000 tons to 100,000 tons per month and plans are afoot for sinking a new shaft system in the eastern section of the mine which was the scene of encouraging borehole results. Prospects for a further improvement in profits are favourable at this rich gold and uranium producer.

Apart from the development of its established interests, the Corporation, through associated exploration companies, is engaged in large-scale prospecting operations throughout Southern Africa, and also in a reserved area of 34,000 sq. miles in Tanganyika. Nor is it neglecting the field of non-mining investments. It has acquired an interest in the Rhodesian iron and steel industry; in afforestation in Swaziland and in the exploitation of processed timber products; and has sponsored, in association with others, new merchant banking and financial institutions in the Union and the Rhodesias which are involved in the development of short-term money markets in these centres. Active steps are thus being taken to maintain the Corporation's outstanding position in the economies of Southern Africa.

As the foregoing consideration indicates, the size of the Anglo American group cannot be judged by the financial structure of the parent company alone. Moreover, as none of the main secondary companies are subsidiaries, the consolidated accounts do not help. Despite the shortcomings through the effect of interlocking interests, the scope of the enterprise may perhaps be more accurately gauged from a consideration of the following summary of the net assets (with shareholdings at market value) of the principal companies of the group:

Company	*Net assets £ million*	*Date*
Anglo American	65	Dec. 31, 1956
Anglo American Investment Trust	24*	Dec. 31, 1956
Rhodesian Anglo American	67	June 30, 1957
West Rand Investment Trust	21	Dec. 31, 1956
O.F.S. Investment Trust	38	Dec. 31, 1956
African and European	17	Dec. 31, 1956
Rand Selection	18	Sept. 30, 1957
	£250M.	

*Substantially greater if a valuation were placed on the investment in Diamond Corporation which is taken in at cost.

There is, in addition, many millions of long and short term loan capital employed by the Group; and consideration should also be given to the strength of the senior, and associated, De Beers Consolidated group with net tangible assets of the order of £100,000,000 at the end of 1957.

This is some measure of the material achievements of one of the greatest financiers the world has known. His record as an humanitarian and a gentleman are less tangible, but no less great.

URANIUM PRODUCTION, 1957

COMPANY (Year to Dec. 31 unless otherwise noted).	*ORE RESERVES*		*DEVELOPMENT*			*PRODUCTION*			
	Tons (000)	*Grade* (lb./ton)	*Ft. Sampled* (000)	*% Payable*	*Value* (in./lb.)	*Tons Treated* (000)	*Grade* (lb./ton)	*Gross Profit* (£000)	*Rate of Redemption of Loan* (£000 p.a.)
Dagga ..	4,134	0·42	18·4	18	17·4	1,484	0·40	1,779·2	563·1
Loraine† ..	1,043	0·21	35·3	27	18·9	611	0·24	319·9	*
P. Brand† ..	3,043	0.35	9·0	90	18·4	763	0·28	479·9	*
P. Steyn† ..	3,927	0.37	24·0	70	22·0	982	0·29	744·2	*
Vaal Reefs ..	1,813	0·84	24·6	76	39·9	750	0·67	1,413·6	280·6
Welkom† ..	3,471	0·32	13·3	70	22·4	373	0·27	317·8	*
W. Reefs ..	4,546	0·51	40·3	48	32·0	2,571	0·26	1,861·6	676·7

†Year to September 30. *Members of Joint Scheme.

De Beers Consolidated Mines Ltd.

Death of Sir Ernest Oppenheimer

THE year 1957, notable as it was for further progress and expansion in the diamond producing industry nevertheless will always be remembered in the annals of De Beers Consolidated Mines for the grievous loss of Sir Ernest Oppenheimer, the company's chairman. Sir Ernest, who died in Johannesburg on November 25 last year, assumed guidance of De Beers nearly 30 years ago at a time when the diamond industry was about to face its sternest test for more than 50 years.

It is now a matter of history how the industry's difficulties of the early 1930's were largely overcome; how the world's producers were gradually brought together so that orderly marketing of stones could be achieved; and how, eventually, the African mines and those elsewhere, were ultimately able to prosper in a disciplined fashion from the great revival for diamonds in the recent post-war years. In all this, through the good times and bad, Sir Ernest was always the architect not only of De Beers own prosperity but of the improved stability and orderliness which the industry throughout the world has been able to enjoy.

It would be merely trite to say that Sir Ernest cannot easily be replaced. His personal love of diamonds, which was undisputed, and his commanding knowledge and long experience of all aspects of the industry was and will long remain altogether unequalled. At this time, it is most reassuring to know that his major policies for the diamond industry already have become fully effective and that he has been succeeded as chairman of De Beers by his son, Mr. Harry Oppenheimer, than whom no one can have been more rigorously trained in diamond lore and all that it connotes. It scarcely needs to be emphasized that all of the De Beers traditions from Rhodes downwards will be thus fully maintained in the future.

It is apposite to recall how, over the years, the present system of marketing and production in the diamond industry has been developed along the lines of what has been called an "enlightened monopoly." Outside the trade there has for long been the ill-informed opinion that the diamond producers of the world either held large stocks of stones or that they have controlled production in order to create artificial shortages and so maintain prices at an excessively high level.

These views, though sometimes still occasionally heard, have been substantially vitiated by the two important principles operating in the diamond trade. The first is that the selling arrangements in force contain provisions by which each producer is guaranteed, over a period of years, that whatever conditions may befall, his sales will not drop below an agreed minimum. The second principle is the fact, that, within the limits of prudent and economic mining, the industry has equipped all its mines to operate at their optimum capacity. Sir Ernest stated in 1953 that when the trend of prices and demand have warranted, considerable sums have immediately been spent in reopening old mines that previously could not have been profitably exploited. The record speaks for itself. Since the war, large capital sums have been spent in order to increase production in the Belgian Congo and Portuguese West Africa. In the De Beers group itself, the famous Premier mine near Pretoria was reopened at a cost of nearly £4,000,000 and the Jagersfontein mine at Kimberley at a cost of nearly £2,000,000. On the wild Atlantic beaches of S.W. Africa, much has been spent in stepping up the production of Cons. Diamonds of S.W. Africa.

If Sir Ernest was able to state in 1953 that there was no agreement between producers for a restriction of output, it is quite certain that his successor is presently in a position to say exactly the same thing. And it certainly is still true to say of the important African producers that their mining operations are conducted on a scale dictated solely by the nature of their deposits to the full capacity of their treatment plants in which, it is agreed, there has been a general expansion in recent years.

DIAMOND SALES

Since the end of the war, and more particularly during the past eight years, there has been an increasing demand for gem and industrial diamonds. Annual sales of newly mined stones handled by the Central Selling Organization on behalf of most of the world's producers—this accounts for about 95 per cent of output—has risen from a total for gems and industrials of £28,400,000 in 1949 to £50,900,000 in 1950 and, subsequently, to the new record level of almost £76,800,000 last year. This unprecendented turnover in 1957 was helped by an increase of about 5.7 per cent in gem prices at the beginning. At the same time two grades of industrial stones also became dearer by about 8.5 per cent. The overall increase in sales last year was achieved mainly by reason of a higher turnover in gems, but sales of industrials were virtually maintained at just under £24,000,000 despite the cessation of U.S. stockpiling except of crushing boart during the year. At the annual meeting of De Beers in May, 1957, Sir Ernest was again warning that the cessation of U.S. stockpiling would mean a decrease in the volume of industrial stones sold. Although stockpiling did, in fact, stop at the beginning of 1957 Sir Ernest proved to be conservative in his estimate so far as that year's figures were concerned. He may, however, have been no more than premature since in the first quarter of 1958 sales of gem stones have fallen to £10,500,000 against £12,300,000 in the last three months of 1957 and £15,100,000 in the quarter before that. Similarly, the turnover in industrials in the first quarter of this year has fallen to £4,800,000, against £5,400,000 and £6,300,000 respectively in the two previous quarters.

With the American recession still showing no positive signs of coming to an end, it was no more than to be expected that sales of diamonds would not be maintained at last year's record levels. The setback has indeed come later than might have been thought but its severity is not such as to cause alarm to the industry. A quarterly turnover of £15,300,000, it has to be remembered, would still be equivalent to an annual rate of over £61,000,000 which was the level roughly achieved during the years 1953 and 1954. The annual business of well over £70,000,000 a year which has been seen in the past three years has probably been regarded by the trade itself as something exceptional and not always likely to be maintained. At this writing it may be said, therefore, that the diamond producing industry is continuing to enjoy relative prosperity and that a further considerable setback in sales would need to be seen if the producers' position were to be substantially weakened.

In this context, it is appropriate to recapitulate the basic strength which underlies the industry's marketing organization. It was some 12 years ago that the Selling Organization was completely remodelled. The handling of gem diamonds was taken over by the Diamond Purchasing and Trading Co. and its associate, the Diamond Trading Co. At the same time the marketing of industrial stones was put in the hands of Industrial Distributors (1946) Ltd. and its wholly owned subsidiary Industrial Distributors (Sales) Ltd. The great majority of the share capital of these selling companies is held by the important producers—not only those in the De Beers Group but also those operating outside South Africa and South-West Africa. In all this, the Diamond Corporation, a subsidiary of De Beers, plays the vital and important role of acting as a link between the South African and other producers.

In 1930-31, the Corporation had taken over approximately £13,000,000 of diamonds at the extraordinarily low prices ruling at the time. During the many years of severe depression, deliveries from this stock were more than replaced from new purchases at even lower prices. Explaining this some years ago Sir Ernest said when stocks could at last be disposed of, the industry was in the midst of the greatest boom the diamond trade had seen. Prices of diamonds had recovered and had benefited from the two devaluations of the pound sterling. We reaped, he said, a "golden harvest," the Diamond Corporation's cash resources rising to £40,000,000.

This immense capital accrual was forced on the group by the restraint placed on the disposal of our stocks. It was not a profit in the ordinary way of business. It would never recur. The Diamond Corporation therefore earmarked £20,000,000 for the protection of the diamond trade, and has employed the remainder of its resources in the establishment of the De Beers Investment Trust. During 1956 the capital of the Diamond Corporation was increased to £20,300,000 in shares of £1 each, all of which are fully paid and issued.

Surplus funds of the Diamond Corporation have been employed through De Beers Investment Trust, in furthering the development of the African Explosives and Chemical Industries whose activities include increased output of dynamite, cyanide and fertilizers, all directly connected with the expansion and development of mining and agriculture in the Union and the Rhodesias. Participa-

Aerial view of the surface installations at the Premier Mine.

tion was taken in the development of the gold mining industry on the Far West Rand and in the Orange Free State.

It is worth recalling this situation, which is substantially unchanged to-day in order to reassure observers who may pessimistically feel that the diamond producing industry might find itself in the same extremely vulnerable position that obtained at the beginning of the 1930's. This foregoing review of the diamond trade position and prospect is, of course, essential in any appraisal of De Beers itself. In 1956, De Beers own profit after tax dropped from £10,000,000 to £9,600,000, this being attributable solely to a decline in sales from the company's own mines. Investment income was higher. The accounts of the parent company alone do, of course, provide only a partial picture of the strength of the De Beers Group as a whole.

The consolidated accounts, which take into consideration the experience of important diamond subsidiaries such as Premier (Transvaal) and Consolidated Diamond Mines of South-West Africa, revealed an altogether different story for the year 1956. Income on diamond account was substantially higher at £33,700,000 (£30,400,000), investment income rose to £6,400,000 (£5,500,000) and total revenue just topped the £41,000,000 mark, compared with £37,100,000 in 1955. Group profits, after taxation, were £20,600,000 compared with £21,000,000, but this was also after £2,700,000 against nil had been written off investments.

As we go to press only preliminary profit figures have been announced in respect of 1957, these referring solely to the earnings of the parent company. They have been enough to show that the past year was again a very good one as was to have been expected in view of the record turnover in stones last year. De Beers profits without taking into consideration its participation in the earnings of subsidiaries, rose to nearly £11,500,000 last year, against just under £10,900,000 and since there was a lower tax requirement, net profits were up from £9,570,000 to £10,300,000.

For a long time De Beers dividend policy has always been an extremely cautious one. Since 1951 annual distributions on the 5s. deferred shares have been regularly maintained at 200 per cent despite the fact that annual earnings have frequently been twice this amount. The usual 200 per cent dividend on the issued deferred capital of £4,083,819 has again been forthcoming in respect of 1957 and, except under conditions of an unforseeably bad slump, it is difficult to think that a 200 per cent annual dividend cannot be indefinitely maintained.

The fortunes of the De Beers Group must for a long time be mainly indentified with the diamond producing and marketing industry. In 1956 as much as 82 per cent of the Group's total revenue was still being derived from diamonds and this figure would be higher if royalties were taken into account. Yet it would be wrong to suppose that De Beers and all its associates does in fact start and finish with diamonds. In recent years, some criticisms have been levelled at the company for its embarking into other fields. Such criticisms have been ill-informed since they have always ignored the role which Cecil Rhodes had in mind when he founded De Beers so many years ago. In the 1870's the diamond mining industry in Kimberly, then a heterogeneous collection of small producers, was unified under one control by Rhodes in the name of De Beers Consolidated Mines. But it was never intended that De Beers should stop there.

Rhodes, the visionary, saw in De Beers not only an instrument for developing and co-ordinating the diamond wealth of South Africa—the world's other major producing fields were to be discovered many years later—but also a means by which the whole of Africa south of the Zambesi could be opened up and developed in terms of transport, minerals, industry and the like. It has thus always been in the true De Beers tradition for the company to interest itself in spheres beyond diamond mining alone. There is therefore no cause either for surprise or criticism in the fact that the Group since the war has been expanding beyond diamonds.

Non-Diamond Activities

The African Explosives investment, to which reference has already been made and a joint interest in which is held with Imperial Chemical Industries, is perhaps one of the De Beers Group most important non-diamond activities. African Explosives in the past two or three years has been carrying out a large new capital programme the benefits of which are now being reaped. Full expansion here, however, still has some way to go and in 1957 it was revealed that this company was undertaking further major extensions schemes in order to keep pace with the development in Southern Africa. Sir Ernest Oppenheimer pointed out last year that there is an ever increasing demand for explosives, fertilizers, industrial chemicals and other important manufactures which the company produces. "We take particular pride in this company," said Sir Ernest. De Beers Consolidated interest in Explosives derives from its substantial holding in De Beers Industrial Corporation.

Additional "outside" interests are held through De Beers Investment Trust which participates in both the Union and the Rhodesian Federation in investment, in industrial concerns, in West Rand and Orange Free State gold mining, in coal and in copper. Dividend income from these sources has been steadily increasing and over the years to come it may be expected that De Beers Investment Trust will be a growingly important contributor to De Beers Consolidated revenue.

At the end of 1956 the De Beers Group consolidated balance sheet showed that the value of non-diamond investments, including loans to companies similarly unconnected with the diamond industry, plus the Group's net cash assets, amounted to as much as £83,000,000 taking stock market prices where applicable, out of a total balance sheet figure of £153,000,000. Net quick assets alone out of the total amounted to as much as £44,300,000 a fact which again emphasizes the enormous underlining financial strength buttressing the diamond market against any possible setback of major proportions. In sum, the position of De Beers Consolidated with its producing and marketing subsidiaries and its important associates, remains as strong as ever so far as diamonds alone are concerned and may well be strengthened further by the many other interests of the Group in the coming year.

As for diamonds alone, it would not be fair to conclude this review without reference to the claims which have been made for the production of synthetic diamonds by the General Electric Co. of America. In the field of science, G.E.C.'s achievements in this direction over the past two years may well be deserving of high praise. Last year Sir Ernest Oppenheimer congratulated the scientists concerned on "A striking scientific achievement" but, he said, it was too soon to make predictions as to where this achievement might lead. In the field of abrasives it was apparent that a further investigation was called for before the synthetic article could compete with the natural one as regards both cost and quantity. The accumulative information to date on the subject of the U.S. achievements in the synthetic field has not suggested more than that a very small size stone, say about the size of a grain of sand, can as yet be artificially produced. The prestige value of these developments to General Electric of America may well be considerable. It can also be appreciated that the U.S. is entirely dependent for industrial diamonds on foreign fields. For the U.S. it would be plainly desirable on strategic grounds for an artificial diamond industry to be created. So far, there is no evidence that bulk production of industrial stones on an economic basis can yet be envisaged. The possibility of artificial gems being manufactured seems to most observers extremely remote and it is the sale of gem stones that contributes the bulk of the income of De Beers and the industry generally.

Central Mining Finance Ltd.

A REORGANIZATION of Central Mining and the Corner House Group has taken place during the last year, and, in view of the many complicated changes that have been made concerning the administration and operations of the Group, a brief chronological review of these happenings is given below.

In our last *Annual Review* it was stated that, following the sale of the Trinidad Oil Co., in which Central Mining had the largest single shareholding, and the discontinuance of merger negotiations with the Consolidated Gold Fields of South Africa Ltd., the assets and business of the Corporation were taken over by Central Mining Finance Limited, whose entire capital is, and will be, held solely by the Corporation, the function of which is now that of a holding company.

At the beginning of May, 1957, it was proposed that the million £1 Preference shares should carry one vote each as against one vote for every five and that the fixed dividend of 5 per cent should be raised to 6 per cent. At the same time, in the event of winding up or a reduction in capital the "Spens formula" was to apply to the Preference capital. Ordinary shares should also be given one vote each as against one vote for eight previously. It was proposed further that the authorized capital should be increased from £6,000,000 to £10,000,000 by the creation of 4,000,000 new unclassified shares of £1 each. These resolutions were passed at an Extraordinary General Meeting held in May.

In August, it was announced that Central Mining intended to transfer to Rand Mines Ltd. its Executive and Technical Departments in South Africa as from September 1. For over half a century, the Group has been operated directly by Central Mining, Rand Mines providing Secretarial services only, but Lord Baillieu said in his annual statement that it had become apparent in recent years that there were some disadvantages in a system whereby the technical and executive services for a number of important South African companies were provided by a British company with its Head Office 6,000 miles away in London. Central Mining remains the largest single shareholder in Rand Mines and participates in the executive direction of that Company. It will continue to provide financial service to the Group and maintains direct links through Board representation with the companies it comprises.

It was interesting to note from the Chairman's Annual Review that at June 30, 1957, Central Mining's Portfolio of shares in and loans to other companies was distributed as follows:

64 per cent in South Africa;
11 per cent in the Western Hemisphere; and
23 per cent in the United Kingdom.

In addition the company held substantial investments in the form of Government Securities both in the United Kingdom and in South Africa, so that, in total, at June 30, 53 per cent of its assets were outside and 47 per cent inside South Africa. Canada, the Rhodesias and Australia were mentioned as possible areas for expansion when suitable opportunities arose, although the company's traditional investment position in South Africa will be maintained.

In May this year, Mr. Frames having reached the retiring age, will resign the Chairmanship of Rand Mines Ltd. He will be succeeded by Mr. C. W. Engelhard with Mr. W. Marshall Clark and Mr. G. V. R. Richdale as Deputy Chairmen. Owing to Mr. Engelhard's numerous commitments in the United States, he will occupy the Chair only until the end of 1959.

GOLD MINING INTERESTS

BLYVOORUITZICHT GOLD MINING CO. LTD.

Comparing the results for the year to June 30, 1957 with those for the previous year, there was a small drop in the tonnage milled, but there was an increase in the number of ounces of gold recovered, due to a rise of 0.109 dwt. in the yield per ton. These factors, combined with a slightly higher price for gold, enabled the working revenue to show an increase of 1s. 11d. per ton milled. Mainly due to higher labour charges, working costs absorbed 11d. per ton milled of this benefit, leaving the working profit from gold operations some £49,000 higher at £5,256,000. Following improvements to the uranium plant during the year, a greater quantity of slime was treated for uranium oxide and there was also an increase in the yield of uranium oxide per ton as a result of better recovery practice. The working profit from this source, before deduction of interest and loan repayments, was £219,000 higher at £1,412,000. Dividends were maintained at the level of 2s. per share.

Development work accomplished and the footage sampled showed small increases. Sampling revealed a lower percentage payability at 89.4 per cent but there was an appreciable increase in the average value at 940 inch-dwt. The increase was partly due to the fact that proportionately more of the development was carried out in the lower levels of the Central and Eastern Sections.

As the underground workings grow bigger the mine has to cope with more water. In order to keep well ahead of requirements, the pumping capacity has been increased to 18,500,000 gallons per day and still further pumping equipment is being installed.

A new company, Western Deep Levels Ltd., was formed last August to exploit an area of approximately 4,767 morgen lying immediately to the South of the Company's property. Western Deep Levels will be under the administrative and technical management of the Anglo American Corporation of South Africa Ltd. The Blyvooruitzicht Co. made available a portion of the mineral rights included in the lease area and has received £150,000 as vendor consideration. This sum was utilized to subscribe at par for 150,000 £1 shares in the initial capital of Western Deep Levels. In addition the company was paid some £57,000 as a refund of drilling expenses.

CITY DEEP LTD.

Compared with 1956 there was a drop of 71,000 in the tonnage milled which was brought about chiefly by the decline in the labour strength and a notable reduction of 3.4 inches in the stoping width to

FINANCIAL RESULTS
(for the last two complete financial years)

COMPANY (*Year to Dec. 31 except where otherwise noted*)	*ORDINARY SHARES IN ISSUE*	*PROFIT AND LOSS RESULTS* £(000)								*Capital Expenditure*† £(000)		*DIVIDENDS PER SHARE* Paid			
		Working Profit		*Uranium Profit (c)*		*Taxation and/or Mining Lease*		*Net Profit After Tax**				1957		1956	
		1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	*Fin.* s. d.	*Int.* s. d.	*Fin.* s. d.	*Int.* s. d.
Blyvoor *a b*	24,000,000 (2/6)	5,255·8	5,207·3	867·6	694·0	3,263·3	3,143·1	2,947·6	2,821·8	254·5	261·7	1 0	1 0	1 0	1 0
City Deep	2,026,832 (£1)	196·5	90·2	—	—	11·5	—	256·8	124·0	77·0	74·1	6	6	6	—
Cons. M.R. *a*	1,247,602 (£1)	124·1	190·7	—	—	8·1	7·5	171·0	218·4	Cr.0·5	Cr.5·4	1 3	1 6	2 0	2 6
Crown	1,886,125 (10/-)	72·7	229·0	—	—	19·2	20·2	199·1	296·0	Cr.15·3	Cr.88·2	1 3	1 0	2 0	3 0
Durban	2,325,000 (10/-)	640·8	656·9	—	—	144·1	119·6	560·8	575·8	87·3	101·9	1 6	1 6	1 6	1 3
E.R.P.M.	3,960,000 (10/-)	1,840·8	2,173·5	—	—	510·1	646·5	1,429·8	1,588·2	468·0	534·9	2 3	2 3	2 6	2 0
Harmony *a b*	18,000,000 (5/-)	1,935·2	1,791·3	703·1	680·1	—	—	2,751·4	2,461·9	1,885·0	1,479·5	6	6	—	—
Modder East *a*	930,805 (£1)	90·4	87·1	—	—	15·2	16·3	101·2	84·1	—	Cr.25·0	1 0	1 0	1 0	1 3
Rose Deep	700,000 (9/6)	32·5	10·9	—	—	3·2	1·0	58·3	24·1	Cr.13·8	0·3	—	—	—	—
Transvaal G.M.E.	952,500 (3d)	32·8	L 1·2	—	—	—	Cr.6·4	22·0	51·8	Cr.10·1	9·1	—	—	10	5
Blyvoor	Results for the six months to December, 1957	2,658·1	2,607·2	555·9	355·2	1,818·6	1,543·6	1,465·1	1,482·1	89·0	180·4	—	—	—	—
Cons. M.R.		57·4	56·3	—	—	4·4	4·2	67·8	71·5	—	—	—	—	—	—
Harmony		1,001·5	976·4	432·7	299·3	0·3	0·1	1,447·2	1,297·7	832·9	921·1	—	—	—	—
Modder East		18·2	51·3	—	—	6·0	8·8	24·3	54·8	—	—	—	—	—	—

a Figures shown are for years ended June 30, 1957 and 1956. *b* Uranium producer. *c* After deduction has been made for redemption and interest of uranium loans.
*Includes sundry revenue less sundry expenses. † Excludes capital expenditure on uranium.

38.9 inches. As a result, despite an improvement in the yield per ton milled, the working revenue fell by £123,000. On the other hand, the continued reorganization of the mine led to further economies in working costs which were £229,000 lower than the previous year. Consequently, the working profit was £106,000 higher at £196,000. Dividends declared totalled 1s. per share as against 6d. per share in 1956.

A pilot winze is being sunk to explore the down-thrown reef on the southern side of the Vierfontein dyke which should intersect the reef towards the end of this year.

Although it has been possible over recent years to continue operations in the Eastern Section of the mine on a marginal basis, the stage has now been reached where, to avoid losses, work in the upper portion of this area must be confined to reclamation and the extraction of shaft pillars. Accordingly the decision has been taken to curtail operations and as from June 1, 1958 the ore milled will be reduced to some 110,000 tons per month. It is expected that the balance of operations at the mine will thus be improved and profitability established on a safer level.

CROWN MINES LTD.

The major reduction planned in the scale of operations to offset the declining trend of mining results was put into effect during the period February/April, 1957. Although the working profit was rather less than one-third of that for 1956, the reorganization that took place changed the position from one of persistent losses to one of modest but rising profits. This was achieved by abandoning the lower levels of the south eastern portion of the mine, by closing a vertical and various incline shafts in this area, by ceasing normal operations in one of the three reduction plants and by a large reduction in the labour force. The further success of the reorganization will depend on the absence of any serious interruptions in shaft pillar extraction work or other untoward circumstances.

EAST RAND PROPRIETARY MINES LTD.

Despite slight increases in the tonnage treated and in the quantity of gold produced, the working profit for 1957 at £1,841,000 was some £333,000 lower than for the previous year due to an appreciable increase in working costs.

It has been decided to hoist men and materials at the Far East Ventilation Shaft System and to deepen the subvertical portion of this shaft system by about 1,600 feet so as to intersect the reef horizon on the 68th level at a depth of about 9,500 feet. The vertical portion of the shaft system has been sunk to its final depth of 5,099 feet and the subvertical portion had reached a depth of 73 feet below the collar at the end of 1957.

DURBAN ROODEPOORT DEEP LTD.

Despite an increase in revenue of £102,000 the working profit was £16,000 less than that of the previous year, chiefly due to increased charges for labour, stores and electricity.

The results of development work on the Kimberley Reef, which accounts for some 58 per cent of the total, gave values of 361 inch-dwt. or fractionally higher than in 1956.

Capital expenditure for the current year is estimated at £260,000 in connection with the supply of additional power to Nos. 5 and 5a Shafts, extensions to No. 5a Shaft, hoisting equipment and the installation of a pumping scheme from the lower Western Section to No. 5a Shaft.

HARMONY GOLD MINING CO. LTD.

The tonnage milled during the year ended June 30, 1957, totalled 947,000 tons compared with 897,000 tons in the previous year, and the yield per ton at 7.80 dwt. was just over 0.1 dwt. higher. The higher cost of pneumoconiosis charges, European labour, electric power and the disposal of underground water resulted in a rise in working costs of 9d. per ton milled.

By comparison with the previous year the working profit from gold operations at £1,935,000 was £144,000 higher, and that derived from uranium operations at £1,175,000 (before deduction of loan and interest repayments) was £115,000 higher, Dividend distributions totalled 1s. per share. For the current year the rate has been increased to 1s. 9d. per share.

Full-scale sinking and equipping of No. 2 Shaft began in September, 1956, and by the end of March, 1958 the shaft had been sunk to a depth of 5,394 ft. It is expected that this shaft will be commissioned early in May. The reduction works were being expanded at the same time to operate with a capacity of 150,000 tons per month. By the middle of this year production will be increased and thereafter built up gradually. It is planned that the actual capacity of the plant will be 200,000 tons per month by the beginning of 1960. No other new shaft was envisaged for many years.

During March, 1958 some 3,800,000 gallons of underground water were being pumped daily, which compares with the present installed capacity of the pumping plant of 8,000,000 gallons per day. The problem of disposal of the mineralized water, which is saline, is being met by increasing the size of the evaporation dams and a pipeline is being laid to areas recently bought on farms lying to the east of the lease area. In addition, following successful pilot plant tests, a 2-3,000,000 gallons per day demineralization plant is being constructed (jointly with certain other gold mining companies in the O.F.S.) to determine whether it will be economic to render the water innocuous and usable by such treatment.

Although the additional quantity of uranium which would be produced as a result of extensions to the plant had been accepted under the existing price formula, it had not proved possible to obtain further loan facilities from the South African Atomic Energy Board—the medium through which the expenditure on the original plant had been arranged.

However, in September, 1957 the company was able to secure loan facilities to the extent of £2,000,000 at 6½ per cent drawable in four quarterly instalments from October 31, 1957. The loan is repayable in half-yearly instalments of £500,000 each commencing on June 30, 1960, but may be repaid at any time after 31.12.1959, in whole or in part. This finance, together with appropriations from profits, will provide the necessary funds to complete the current year's capital programme which amounts to £2,900,000 in respect of the sinking of No. 2 Shaft, the extension of both the gold and uranium plants, disposal arrange-

DEVELOPMENT AND MILLING RESULTS
(for the last two complete financial years)

COMPANY (Year to Dec. 31 except where otherwise noted)	TOTAL ORE RESERVES			DEVELOPMENT RESULTS						MILL THROUGHPUT													
				Ft. Sampled (000)		Payability %		Av. Value (In.-dwt.)		Tonnage Milled (000)		Cost per Ton		Gold Recovered Ounces (000)		Grade (dwt./ton)		Cost per ounce		Working Profit Per ton		Per oz.	
	Tons (000)	Value (dwt.)	In.-dwt.	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956
Blyvoor *a*	6,310	12.7	585	18·6	17·2	89	95	940	764	1,264	1,267	60/2	59/3	718·4	713·2	11·4	11·3	105/10	105/2	83/2	82/2	146/4	146/-
City Deep	4,015	5·8	243	23·3	29·9	31	39	294	332	1,780	1,851	46/11	47/7	347·9	357·4	3·9	3·9	240/2	246/7	2/3	1/-	11/4	5/-
Cons. M.R. *a*	2,690	4·2	215	22·6	21·3	29	34	300	337	2,000	2,035	33/7	33/6	276·5	286·5	2·8	2·8	243/1	237/9	1/3	1/10	9/-	13/4
Crown	7,599	4·8	216	32·6	61·0	32	35	312	307	2,836	3,395	36/6	37/4	417·1	521·8	2·9	3·1	248/1	242/10	6d	1/4	3/6	8/9
Durban	8,445	4·0	240	34·4	34·0	52	50	382	395	2,192	2,188	38/7	37/7	387·2	378·9	3·5	3·5	218/6	217/-	5/10	6/-	33/1	34/8
E.R.P.M.	5,590	6·4	302	11·6	18·3	52	45	414	456	2,634	2,548	50/4	48/3	673·7	661·5	5·1	5·2	196/10	185/11	14/-	17/1	54/8	65/8
Harmony *a*	2,292	8·5	463	12·0	19·1	81	71	546	468	947	897	57/6	56/9	369·6	345·6	7·8	7·7	147/4	147/2	40/10	39/11	104/8	103/8
Modder East *a*	1,223	3·4	138	3·6	7·2	39	15	180	199	1,671	1,577	24/10	25/4	171·8	165·6	2·1	2·1	241/10	240/11	1/1	1/1	10/6	10/6
Rose Deep	423	4·3	232	2·4	7·1	37	45	436	296	610	534	36/9	39/8	91·7	85·1	3·0	3·2	244/6	249/2	1/1	5d	7/1	2/7
T'vaal G.M.E.	53	9·4	—	7·2	5·3	25	41	346	250	165	210	58/11	57/7	35·4	42·0	4·3	4·0	274/1	288/3	4/-	L 1d	18/6	L 7d
Blyvoor	Results for the six months to December, 1957			8·2	10·1	89	89	679	981	619	632	63/11	58/11	370·1	355·3	12·0	11·2	106/11	104/9	85/10	82/6	143/8	146/9
Cons. M.R.				7·8	13·1	32	30	240	296	920	992	36/2	33/10	137·0	138·0	3·0	2·8	242/10	243/4	1/3	1/2	8/4	8/2
Harmony				7·1	5·4	91	81	619	501	495	463	59/8	56/5	197·7	181·6	8·0	7·8	149/3	140/4	40/5	42/2	101/4	107/6
Modder East				1·3	2·7	23	52	185	182	828	836	24/11	24/9	83·7	86·3	2·0	2·1	246/8	239/11	5d	1/3	4/4	11/10

a Figures shown are for years ended June 30, 1957 and 1956. L indicates a loss.

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COLLIERY INTERESTS

WITBANK COLLIERY LTD.

(Issued Capital: £385,000 in £1 shares. Year end August 31)

The coal despatched from the mine amounted to 1,693,000 tons, of which 83 per cent was delivered from the Wolvekrans Section and the balance from the Southern Section. This output reflected a decrease of 54,000 tons compared with the previous year, caused mainly by the serious shortage of non-European labour at Wolvekrans. Consequently, the working profit fell by £7,000 to £381,000.

Since the closing of the Company's financial year the installation of the modern underground conveyor system at Wolvekrans has been completed and replaces the endless rope haulages which were being used at both shafts.

Railway transport limitations again hampered the efforts to satisfy coal demands, and within a radius of 120 miles of the pithead considerable quantities are delivered by road to consumers. The Railway Administration has taken steps to improve the main line from the coalfield area to the Witwatersrand by laying a third line over two sections of the route. It is their intention to electrify the whole Witbank/Rand system, thereby considerably increasing its carrying capacity.

The steps taken by the Company in the last five years in order to maintain the quality and volume of its output and to counter the labour shortage include the erection of a washing plant and the modernization of the main underground haulage system. Should the labour position further deteriorate it may, in addition, prove necessary to install a certain amount of mechanized face equipment. Heavy capital expenditure has been incurred and may in future be necessary to maintain the Company's productive capacity.

Dividends totalling 7s. 6d. per share were declared during the year—an increase of 1s. per share over the previous year. In February, 1958, a dividend of 4s. per share was declared in respect of the first half of the Company's current financial year.

INDUSTRIAL INTERESTS

THE HUME PIPE CO. (SOUTH AFRICA) LTD.

(Issued Capital: £171,875 in 343,750 shares of 10s. each. Year ends June 30)

Compared with the previous year the volume of business conducted by the Company as a whole showed a small improvement. Due to the decline in building activity in Cape Province the demand for the products of the Belleville brick works, situated in that area, fell considerably.

In the Orange Free State, the concrete pipe factory at Virginia is now in production and sales of piping began in July.

Satisfactory progress has been made by the two wholly-owned Rhodesian subsidiaries. The first sales from the Bulawayo factory were made towards the end of June. In March, 1957 negotiations were concluded for the acquisition of the entire issued share capital of Concrete Industries Ltd., a company registered in Northern Rhodesia, with its works situated at Luanshya. The factory produces concrete pipes and sundry concrete articles related to the building industry for which there has been a consistent demand and its capacity is being expanded.

Although reduced by non-recurring expenditure of £32,000, the trading profit at £618,000 was slightly in excess of the figure of the previous year. Due mainly to a charge of £48,000 for provisions and amounts written off in respect of investments in subsidiary companies, the profit after taxation at £410,000 showed a fall of £45,000 if compared with the figure for the previous year. Distributions to shareholders during the year were increased by 6d. to 11s. per share.

THE NORTHERN LIME CO. LTD.

(Issued Capital: £1,650,000 in £1 shares. Year ends June 30)

The trading profit, before allowing for depreciation, was £85,000 higher at £437,000 and dividends paid rose by 1½d. per share to 1s. 6d. per share.

Total sales of lime and limestone amounted to 608,000 tons—an increase of 28,000 tons compared with the previous year.

The expanding demand for rotary kiln lime from the Silver Streams plant was not satisfied in full owing to the lack of sufficient railways trucks, and accordingly the balance of burnt lime orders was met from the Taung plant, which has now been in operation for 40 years. Thus, as in previous years, the efforts to reduce output from this plant and to make a corresponding increase from Silver Streams again met with no success. The Railway Authorities are fully aware of the difficult position and since the close of the year there has been an improvement in the carrying capacity of the Postmasburg/Kimberley line, which it is hoped will be maintained and so enable the Company to meet its full commitments.

Plans are in hand to connect the Silver Streams plant to the Electricity Supply Commission's power line at the end of this year. Although the use of this power may prove more expensive than from the Company's own generating plant, it will result in a saving of water—obtained from boreholes—required for cooling purposes. In the semi-arid area of the Company's operations the conservation of water is an important factor.

Output for the first four months of the Company's financial year shows an increase over the corresponding period a year ago and a dividend of 10½d. per share was declared for the half-year to December 31st, 1957.

The liquid resources of the Company, which at June 30th, 1957 amounted to just over £200,000, require to be built up to a level consistent with that necessary for providing for renewals and replacements of plant and equipment.

PRETORIA PORTLAND CEMENT CO. LTD.

(Issued Capital: £1,965,937 in £1 shares. Year ends June 30)

Production of cement at the Company's four factories was well maintained throughout the year under review. Shortage of railway trucks at times hampered despatches, and it was necessary to bring large quantities of coal by road, which is more costly than by rail, to both the Hercules and Jupiter factories.

Erection of the new plant at the Slurry factory near Mafeking is making satisfactory progress and should be in production during 1958. Improvements for handling the raw materials at the Jupiter factory (near Johannesburg) have not yet been finally decided upon.

Costs of production still continue to rise but the industry has not so far been granted compensatory price increases.

In particular, the 3d. per pocket allowed producers for fixed assets replacement under the price control regulations is inadequate for the replacement of capital assets.

The Company's subsidiary and associated companies, Cape Portland Cement Co. Ltd., Eastern Province Cement Co. Ltd. and Premier Portland Cement Co. (Rhodesia) Ltd. all operated satisfactorily.

The net profit for the year was £655,000, representing a fall of £42,000. Two dividends of 2s. 3d. and 2s. per share were declared during the year, the latter on the increased capital of 1,965,937 shares.

OIL INTERESTS

WESTERN DECALTA PETROLEUM LTD.

Rather more than a year ago Central Mining decided to invest in Western Decalta Petroleum Ltd. with Selection Trust Ltd., as a partner.

The latter part of 1957 was a difficult time for Canadian Oil producing companies, but it is satisfactory to note that this Company's revenue after the payment of royalties was 64 per cent higher than in 1956.

The net acreage owned by the Company increased by 91,600 to 437,600 in 1957, and 21 producing wells and seven exploratory wells were drilled during the year.

An average of 2,286 bbls. of oil a day were produced although following the reduction in allowables, there was a decrease in the rate of growth towards the end of the year, when the Company had a royalty interest in 419 producing oil and gas wells and a working interest in 163 wells amounting to the equivalent of 86 wholly owned wells.

Crude oil reserves increased from 11,969,500 bbls. at the end of the previous year to 13,600,000 bbls. at the end of 1957. Net revenue amounted to $1,177,580, and of this sum $551,544 is required to pay for long-term debt. The remainder was utilized for exploration, rentals, land acquisition and development.

Union Corporation Ltd.

FOR Union Corporation, registered in South Africa but subject to British taxation, 1957 was a year of considerable progress despite the setback in profits.

The completion of a third shaft at St. Helena, in which the Corporation is so largely interested, places this mine on the threshold of a major expansion in output and profits, whilst the excellent progress at the new Winklehaak mine near Kinross suggests that production should get under way by June or July of this year. Outstanding progress was also made at Stilfontein and Western Holdings, the Corporation's principal interests in Gold Mining Companies not under its administration. Income from each of these investments showed a material increase during the year and, like St. Helena, each holds out the promise of a further material increase in dividend declarations in the years immediately ahead.

Exploration has continued in the Kinross area adjacent to the Winkelhaak mine, and it has been found possible to delineate fairly closely the area of mineral rights which it is desirable to hold. Excluding the ground already incorporated in the Winkelhaak mine, this area amounts to some 26,000 morgen, over most of which mineral rights have already been purchased, the balance being still held under option. Some of this area is deep or appears to be of marginal value under present conditions but, within it, there is a smaller core of approximately 10,000 morgen, equivalent to 14,000 mining claims, forming a compact block which is of more immediate economic interest. Drilling results in much of this latter area have been satisfactory and indeed in some places most encouraging. Work is still proceeding.

There is thus the more or less certain prospect of either two very large mines or three mines of a more normal size being formed to mine this area in the relatively near future, in addition to Winkelhaak. Moreover, there is the indication that additional areas could prove of economic importance if there should be a rise in gold price. The Corporation is thus in the enviable position of having assured more than adequate provision for replacement of those of its gold mining interests with limited lives. This is no mean compensation for the lack of a full measure of good fortune in its pioneering efforts in the Orange Free State, or in its subsequent attempts to close the gap between the West Wits line and Klerksdorp fields.

Other exploration work continues to be carried out in the Union and elsewhere so that adequate steps are being taken to assure the continued progress of the Corporation, which has long been in the forefront of prospecting and exploration in South Africa.

The preliminary profit statement for 1957 reflects a group net profit of £1,578,000 compared with £2,093,000 in 1956 and £1,355,000 in 1955. The 1956 profit was inflated, however, by the exceptionally good returns on its base metal investments—the income from Tsumeb, for instance, would alone have been some £400,000 higher in 1956 than in either 1955 or 1957. It is unfortunate that the setback in income from this source should have occurred at the time St. Helena has begun to contribute more than a relatively nominal income. This position should be rectified within the next year or two.

Reverting to the 1957 profit, the figure given above is given after provision for taxation which cost £108,000 more than in 1956, so that the shortfall in profits before tax was of the order of £410,000. Of the distributable profits for the year in the hands of the parent company of £1,464,000, a sum of £650,000 was transferred to the reserves and two dividends totalling 3s. 0d. per share, less tax (unchanged), absorbed £802,000. The unappropriated profit of the parent company at the year end thus rose by some £12,000 to £401,000.

The issued capital of the parent company remains unchanged at 9,300,000 Ordinary Shares of 2s. 6d. each fully paid. But since the year end, arrangements have been made for the issue of £2,000,000 of unsecured 6½ per cent notes at par, repayable 1974 to 1983. This issue will provide additional finance for the Corporation's business, including the further exploitation of the Kinross goldfield.

The Corporation's gold mining interests can be divided under three main headings namely, the East Rand Mines, the Free State and Klerksdorp mines and Winkelhaak and the Kinross area.

THE EAST RAND MINES

Union Corporation has long enjoyed a reputation for sound and conservative management of the mines under its administration. That this is justified is evident in the affairs of the Group's mines in the Far East Rand where adequate ore reserves have been built up thus facilitating a large measure of stability in operating results.

At East Geduld, currently the second largest and the richest of these mines, ore reserves have shown a steady decline in the past six or seven years but are nevertheless, still equivalent to almost six years' milling at the December 31, 1957, level of 9,300,000 tons averaging 6.0 dwts. per ton over a stoping width of 52 inches. The working profit of £3,523,000 was some £338,000 lower than in 1956 due mainly to a reduction in the tonnage treated. But this fall was largely offset by lower taxation. Dividends for the year totalling 4s. 0d. per share were 3d. lower than in the previous year.

At Grootvlei, which mills the greatest tonnage of any of the Group mines, ore reserves declined by 1,000,000 tons to 14,000,000 tons averaging 4.5 dwts. per ton over 47 inches at December 31, 1957. This is equivalent to about six years milling at the present rate, the reserves being the highest both in terms of tonnage and relative to the annual milling rate, of all the South African gold mines. As the mine is becoming increasingly dependent on the less promising extremities of the claim area, the decline in the volume of the reserves must be expected to continue but their size will assure an orderly change in the affairs of the mine. The working profit of £2,676,000 was £105,000 lower than in 1956 due to an increase in working costs of 7d. per ton to 31s. 0d. per ton. This was partly offset by lower taxation and dividends showed little change at 2s. 4d. per share compared with 2s. 5d. in 1956.

Unlike East Geduld and Grootvlei, Marievale's ore reserves were again higher at December 31, 1957, being 200,000 tons up at 5,200,000 tons. The value was slightly lower at 5.3 dwts. per ton, the estimated stoping width being unchanged at 46 inches. The increase in tonnage was entirely due to a further improvement in the volume of ore on the Kimberley Reef horizon which now accounts for over 20 per cent of the total reserves. The average value of the Kimberley reserves at 4.7 dwts., is notably lower than the 5.4 dwts. per ton average of the main reef ore. The increasing importance of this reef will therefore lead to some reduction in recovery grade but the effects of this are to be offset by increasing the nominal capacity of the reduction works from the present figure of 72,000 tons to 92,000 tons per month. Capital expenditure is being spread over two years and is not expected to affect dividends. The extensions are expected to be completed before the end of 1958 and it is anticipated that the working profit will then show a worth while increase. Profits were well maintained during 1957 and the dividend rate was unchanged at 2s. 3d. for the year.

Results at the old Geduld mine continue to decline and the life is very limited under existing conditions. It is still of

FINANCIAL RESULTS
(for the last two complete financial years)

COMPANY (*Year to Dec. 31*)	*ORDINARY SHARES IN ISSUE*	*PROFIT AND LOSS RESULTS* £(000)								*Capital Expenditure* £(000)		*EARNINGS, DIVIDENDS AND YIELD PER SHARE*			
		Working Profit		*Uranium Profit*		*Taxation and/or Mining Lease*		*Net Profit After Tax*				*Paid* 1957		1956	
		1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	Fin. s. d.	Int. s. d.	Fin. s. d.	Int. s. d.
E. Geduld	9,000,000 (4/-)	3,523.4	3,861.3	—	—	1,861.5	2,041.5	1,769.0	1,918.1	Cr.1.5	8.3	2 0	2 0	2 3	2 0
Geduld Pty.	1,460,857 (£1)	275.3	353.8	—	—	61.2	110.3	972.9	1,026.5	36.7	—	6 6	6 3	7 6	6 9
Grootvlei	11,438,816 (5/-)	2,675.9	2,780.5	—	—	1,359.6	1,409.1	1,348.2	1,399.0	35.7	—	1 3	1 1	1 4	1 1
Marievale	4,500,000 (10/-)	1,021.8	1,065.3	—	—	469.9	497.6	558.4	571.9	22.7	70.8	1 3	1 0	1 3	1 0
St. Helena	9,625,000 (10/-)	2,250.1	2,106.5	—	—	—	—	2,199.3	2,039.1	1,135.8	1,311.3	10	9	7	6
Van Dyk	5,332,000 (9/-)	183.9	30.2	—	—	—	—	201.4	51.0	Cr.4.4	Cr.38.6	—	—	—	—

importance as a holding company, however, as it owns 3,308,425 stock units in East Geduld and 358,400 stock units in Grootvlei. These share holdings are material in relation to Geduld's capital of 1,460,857 stock units. Warning was given during the year that exploratory work at the Van Dyk mine would cease in view of the disappointing result in the No. 5 shaft area. A first return of capital of 1s. 0d. per share was announced in September, 1957 and a second return of capital of 1s. 3d. per share in March, 1958.

ORANGE FREE STATE AND KLERKSDORP INTERESTS

As previously outlined, the Corporation has shareholdings in Stilfontein operating in the Klerksdorp area; in Western Holdings, the O.F.S. producer and in St. Helena, which is administered by the Corporation.

St. Helena again milled the highest tonnage of any of the Free State mines during 1957 and is now well set for a further expansion in output. Development during 1957 averaged 52 per cent payable with an average value of 422 in.-dwt. or much the same as in the previous two years. The ore reserve at December 31, 1957, was unchanged at 3,250,000 tons, averaging 6.1 dwts. over an estimated stope width of 56 inches. In common with the normal practice of the group, development and ore reserves are conservatively valued and with the aid of some sorting, the recovery grade averaged 5.8 dwts. per ton during 1957 and is currently running at 5.9 dwts. per ton. Working costs rose by £166,000 and the working profit by £144,000 to £2,250,000. Two dividends totalling 1s. 7d. per share were paid compared with 1s. 1d. in 1956. A dividend of 1s. 0d. per share was declared in March, 1958. Capital expenditure was again heavy at £1,136,000, but the financial position of the company is very sound with current assets exceeding current liabilities by nearly £900,000 and no short term loans outstanding. There is thus scope for a further improvement in the dividend rate during 1958, although capital expenditure is expected to amount to some £800,000.

The new No. 2 shaft has been completed to a final depth of 5,528 ft. and development in the vicinity of the shaft is now under way. Although the shaft intersection of reef disclosed only negligible values, a subsequent intersection of reef in an ore pass some 80 ft. from the shaft gave a result of 328 dwts. over 18 inches, equivalent to 5,904 in.-dwt. This was followed by a borehole intersection assaying 1,070 in.dwt. at a distance of about 1,000 ft. from the middle of the Company's common boundary with President Brand. This latter result was obtained at a depth of 4,405ft. thus indicating the presence of an upthrow fault in the eastern section of the mine which may well prove to be a continuation of that running through Free State Geduld and Western Holdings.

To the north, at Western Holdings, favourable development results were disclosed near the common boundary with St. Helena which adds strength to the belief that values in the area to be served by the new No. 2 shaft will exceed those in the older parts of the mine. This shaft is expected to start contributing to the mill early in 1959 and it is intended to increase the capacity of the reduction plant by a further 25,000 tons per month to over 150,000 tons per month, to handle the additional ore. The average milling rate during 1957 was 116,000 tons per month so that profits may be expected to show a material improvement when the additional plant capacity becomes operative. The picture may be further enhanced by an improvement in recovery grade if higher values are disclosed in the new shaft area. Earnings are currently running at an annual rate of almost 5s. 0d. per share and liability for taxation is unlikely to be incurred before 1960. There would thus seem to be scope for a considerable improvement in dividends in due course.

WINKELHAAK

Progress at Winkelhaak, which is to work 5,115 claims in the Kinross area some 40 miles to the east of Springs, has been well up to expectations. The initial shaft sinking programme consisting of two small shafts—the Nos. 1 and 3—each with an attendant ventilation winze is complete and work is well advanced on the sinking of the No. 3B shaft which will be used for handling men and material so that the No. 3 shaft can be used exclusively for rock hoisting. All these shafts are in a shallow section of the mine and it is anticipated that they will provide sufficient hoisting capacity to support a milling rate of fully 60,000 tons a month, which is the rated capacity of the initial reduction plant. Production is due to start about the middle of this year. Thereafter, sinking of the No. 2 main hoisting shaft will commence and speedy progress should be made as pre-cementation of the shaft site has been carried out to a depth of 3,500 ft. through a borehole sunk for this purpose. No less than 12,713 pockets of cement were injected into this borehole. At the same time, the capacity of the reduction plant is to be raised to 100,000 tons per month.

During 1957, the rate of development was increased sharply, 10,365 ft. of development being on reef and sampled, of which 6,645 ft. or 64 per cent were payable, averaging approximately 380 in.-dwt. In the March quarter of 1958 no less than 7,415 ft. of development was sampled averaging 62 per cent payable and 332 in.-dwt. The decline in value was mainly due to a narrower reef width and does not indicate much change in the prospective recovery grade. In conformity with normal group practice, the development values have been assessed on a similar basis to ore reserves. On results to date a recovery grade of some 6 to 7 dwts. per ton seems likely which should be sufficient to establish the mine on a sound profit earning basis. During the year a number of additional boreholes were completed, several disclosing promising results ranging up to the 1,515 in.-dwts. in an intersection in borehole WS 19, some 1,800 ft. north of the No. 3 shaft.

As indicated elsewhere, the likelihood is that at least two additional mining companies will be formed to operate in this area.

Other Investments

Outside gold mining, Union Corporation has interests in the Rhodesian Copper Belt through a holding of Selection Trust which, incidentally, also has important interests in the Orange Free State. It also holds shares in San Francisco Mines of Mexico, producer of large quantities of lead, zin cand silver. Chrome Mines of South Africa is another important base metal investment and, according to information given at the last Annual Meeting, the Corporation owns about 360,000 shares, equivalent to some 9 per cent of the issued capital of Tsumeb Corporation, the important South-West African lead, zinc, copper producer. Dividend declarations by this Company in the financial year ended June 30, 1957, totalled 42s. 6d. per share compared with 35s. 0d. per share in the previous year.

The Corporation has interests in industry, partly by a holding of shares in the Bay Hall Trust, which in turn owns investments in industrial companies, and partly by direct interest in British Enka, the well-known producer of rayon, and in South African Pulp and Paper which has paper mills near Johannesburg and in Natal.

During 1957, the Corporation participated with Mr. C. W. Engelhard and Associates of New York, the Anglo American Corporation and certain London Bankers in the formation of a large new South African finance company. Rand American Investment Ltd. which, inter alia, acquired a substantial block of shares in The Central Mining and Investment Corporation Ltd. The Corporation is participating in the management of the new company.

DEVELOPMENT AND MILLING RESULTS
(for the last two complete financial years)

COMPANY (Year to Dec. 31)	TOTAL ORE RESERVES			DEVELOPMENT RESULTS						MILL THROUGHPUT													
				Ft. Sampled (000)		Payability				Tonnage				Gold Recovered						Working Profit			
						%		Av. Value (In.-dwt.)		Tons Milled (000)		Cost per Ton		Ounces (000)		Grade (dwt./ton)		Cost per ounce		Per ton		Per oz.	
	Tons (000)	Value (dwt.)	In-dwt.	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956
E. Geduld ..	9,300	6.0	312	8.6	6.6	54	51	249	256	1,615	1,720	33/7	32/10	496.0	531.0	6.1	6.2	109/5	107/2	43/8	44/11	142/1	143/5
Geduld Pty...	800	3.6	205	9.5	14.6	42	37	234	280	1,144	1,245	35/2	34/3	181.3	197.3	3.2	3.2	221/10	212/7	4/10	5/8	30/4	38/2
Grootvlei	14,000	4.5	212	20.1	22.0	43	48	210	228	2,357	2,344	31/-	30/5	503.6	504.9	4.3	4.3	145/1	141/3	22/8	23/9	106/3	108/11
Marievale ..	5,200	5.3	244	22.7	25.5	31	38	230	271	854	855	42/2	41/2	224.3	224.4	5.3	5.2	160/5	158/-	23/11	24/11	91/1	92/8
St. Helena ..	3,250	6.1	342	16.5	16.7	52	55	422	387	1,392	1,312	41/-	40/11	405.8	380.9	5.8	5.8	140/7	141/2	32/4	32/1	110/11	109/4
Van Dyk	450	4.0	192	13.4	17.2	29	21	304	272	919	953	40/6	40/2	162.6	154.6	3.5	3.2	228/8	247/7	4/-	8d.	22/7	2/7

South Africa

General Mining & Finance Corporation Ltd.

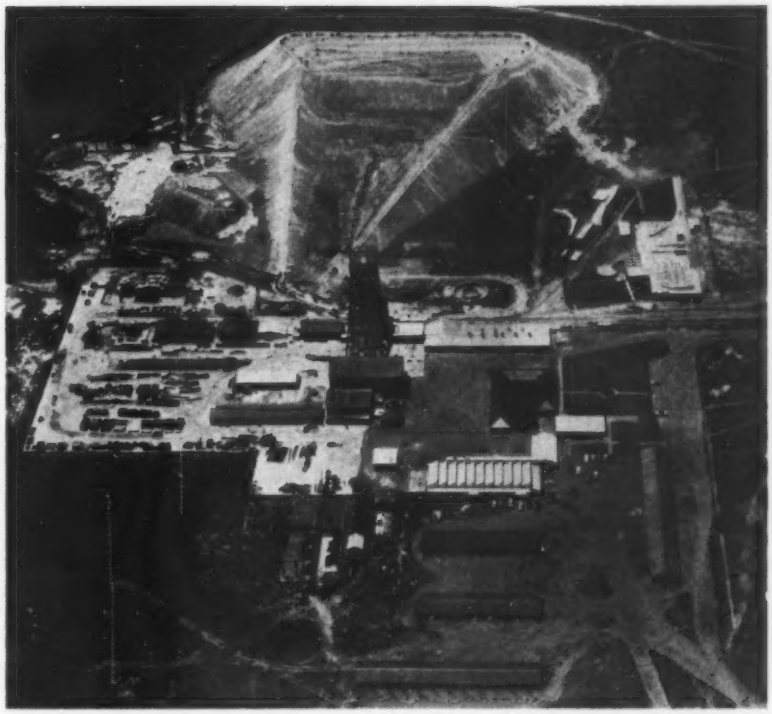
FOR General Mining, registered as a public company as long ago as 1895, and a pioneer in the use of the cyanide process of gold extraction and in the production of uranium in the Union, 1956 was a difficult year. Its substantial investments in new gold mines had either not reached the dividend paying stage or were productive of only a nominal dividend income; the market in gold shares offered little or no opportunity for realizing investments in established enterprises to finance commitments in new ventures; and it was faced with heavy outlays in following up its interests in new ventures such as Riebeeck Mining. Furthermore, it was again necessary to write a substantial amount off investments, following the practice adopted over many years by which individual investments, which have depreciated below book values, are reduced to market values or to Directors' valuation in the case of unquoted investments. In consequence it was considered prudent to reduce the dividend rate from a level of 5s. 0d. per annum on the Ordinary Shares which had been maintained for over 20 years, to 4s. 0d. for the year ended December 31, 1956.

Paradoxically, 1956 will probably be set as the year which marked a turning point in the fortunes of the Corporation for, starting in 1957, its very substantial investments in such new mines as Stilfontein, Buffelsfontein, Free State Geduld and Hartebeestfontein have now begun to yield a material income which should show a steady improvement for several years to come. Evidence of this new trend in the operating results of the parent company is contained in the preliminary profit statement for the year ended December 31, 1957, which shows a net profit after taxation of £1,374,745 compared with £975,468 in 1956 and provides for a fixed dividend of 3s. 0d. making 5s. 0d. for the financial year ended December 31, 1957. Moreover, if the firmer conditions currently ruling in the gold share market should continue, the heavy calls on profits in writing down the value of investments which has been a feature of the Accounts in recent years, should no longer have a bearing on the profits available for distribution.

In normal circumstances it is the function of a Corporation such as this to turn over its working capital by realizing investments in order to provide funds for investment in new enterprises, and to earn share-dealing profits with which to strengthen reserves. As such a policy was not possible owing to the depressed state of the Stock Exchange, arrangements were made during 1956 whereby the Corporation was provided with loan facilities of up to £2,000,000 current until December 31, 1959. At the date of the annual meeting in June 1957, £500,000 was owing under these facilities. Out of the £1,000,000 drawn during the financial year ended December 31, 1956, during which the value of investments in quoted securities at cost rose by approximately the same amount to £9,895,000, the market value at that date being £14,411,000. The increase in the value of the investments was mainly due to the exercising of a substantial participation in the new Riebeeck gold mine. This is the latest of a series of new investments which have transformed the outlook for General Mining since 1949, when investments at cost amounted to no more than £4,000,000.

There has been little change in the capital structure, which is somewhat complex. A total of 750,000 6 per cent Cumulative Convertible Redeemable "A" Preference Shares of £1 each have been authorized and issued. Of these 261,319 shares had been redeemed at December 31, 1956, leaving the oustanding issue at 488,681 such shares. Of the 6 per cent "B" Cumulative Preference Shares of £1 each, 500,000 are authorized and 250,000 are in issue. Finally, there are Ordinary Shares of £1 each of which 3,000,000 are

Aerial view of the Pioneer and Ventilation Shaft area, Buffelsfontein



The Charles Shaft area, Stilfontein

authorized and a further 2,891,336 in issue.

General Mining's investment portfolio is extensive both in the number of securities it contains and in the type of economic activity covered. Nevertheless, the Chairman indicated at the last annual meeting that gold and uranium comprise the main section of the portfolio and that the proportion of such investments in marginal or vulnerable mines was not great. The extent of the investments in new gold mines is also indicated by the comparatively low level of dividend income relative to the total market value of the Corporation's investments.

The Corporation has major direct or indirect investments in the following more important companies (other than subsidiary companies) administered by it:—

Blinkpoort Gold; Buffelsfontein Gold; Doornkop Sugar; Eastern Rand Extensions; Ellaton Gold; Lydenburg Platinum; New Pioneer Central Rand Gold; South Roodepoort; Southern Van Ryn; Stilfontein Gold; West Rand Consolidated.

In addition, it has major investments in African and European; Bancroft Mines; Blyvooruitzicht; Crown Mines; De Beers Consolidated; Doornfontein Gold; Durban Deep; E.R.P.M.; Free State Geduld; Free State Saaiplaas; Harmony Gold; President Brand; President Steyn; Rand Selection; Riebeeck Gold; Scaw Metals; St. Helena; S.A. Pulp and Paper; Ventersspost Gold; Vereeniging Estates; Vogelstruisbult; West Driefontein; West Witwatersrand Areas; Western Holdings and New Consolidated Free State Exploration.

A brief review of the more important interests follows.

THE HOLDING COMPANIES

In New Pioneer Central Rand Gold Mining Co. Ltd., Eastern Rand Extensions Ltd., and Southern Van Ryn Reef Gold Mining Co. Ltd., General Mining has under its wing three important holding companies each of which has substantial investments in the Stilfontein, Buffelsfontein and Hartebeestfontein gold-uranium mines of the Klerksdorp district. That they are important entities within the group may be judged from the following summary of the Market values of investments:

Company	*M.V. of Investments*	*Date*
New Pioneer	£2,641,000	June 30, 1957
E.R.Ex.	£1,070,000	Dec. 31, 1956
S. Van Ryn	£1,198,000	Dec. 31, 1956
	£4,909,000	

Thus these three companies between them have investment portfolios worth upwards of £5,000,000 at current prices compared with the market value of the parent Company's investments at December 31, 1956, of £14,411,000. This clearly illustrates their importance within the group structure.

It is some ten years since prospecting operations on ground near Klerksdorp in which these three companies held a major interest, first met with success. At that time the net assets of New Pioneer were valued at £300,000. Notwithstanding the fact that this company has since then passed on to its shareholders the rights to subscribe for more than 4,500,000 Stilfontein shares, 1,250,000 Hartebeestfontein shares and 1,500,000 Buffelsfontein shares, it has built up its net assets to a present market value of approximately £3,500,000 and its reserves from £300,000 to £922,000. A consideration of the progress of the other two companies would disclose a similar picture.

All three companies have now reached the dividend paying stage, the most recent declarations being 1s. 0d. per share by New Pioneer in June, 1957, 1s. 3d. per share by Eastern Rand Extensions and 5d. per share by Southern Van Ryn in December, 1957. There is ample scope for a material improvement in the dividend rates in the next two to three years as the mining companies increase their declarations.

Whereas the other two companies' interests are almost entirely confined to investments, New Pioneer is, in addition, substantially interested in property. The Stilfontein township and extensions, which house the employees of the Stilfontein, Hartebeestfontein and Buffelsfontein mines, has been developed under its aegis. Although substantial areas have already been sold to the mining companies and private individuals, there are still considerable areas awaiting disposal and the company has retained and developed the only business sites which are available. The rent roll from these properties will continue to grow and the company can look forward to a stable and increasing income from this source. The development of the business sites is continuing and sales of township plots may be expected to contribute to revenue for many years to come. The Ellaton township on the outskirts of Klerksdorp is also under the wing of New Pioneer and also contributes to the income of the company.

Blinkpoort Gold Syndicate Ltd., which General Mining brought under its aegis when it acquired control of the Transvaal Mining Group, is another important holding company with investments worth fully as much as those of the combined New Pioneer trio. It has investments in President Brand, President Steyn, Welkom and Free State Geduld, four of the leading Free State mines. Its major investment is in Free State Geduld which, according to information given in the Director's Report of January 31, 1958, may be estimated at 1,295,892 shares including the rights to which it was entitled in the new issue at 80s. 0d. per share at end December 1957. As the issued capital of Blinkpoort is in the form of 2,500,000 shares of 5s. 0d. each fully paid, rather more than one share in Free State Geduld is held for every two shares in issue by Blinkpoort. The market value of the investments at September 30, 1957, was £4,772,396. This was before the rights in Free State Geduld were exercised and after allowing for this adjustment, the current market value may be estimated at comfortably in excess of £5,000,000 or more than one-third of the market value of the parent companies' quoted investments at December 31, 1956. Dividends totalling 10½d. per share were paid in respect of the year ended September 30, 1957 and an interim dividend of 1s. 3d. per share has been declared for the 1958 financial year. Rising dividends from Free State Geduld, which may confidently be expected, will result in a further marked improvement in Blinkpoort's declarations.

Lydenburg Platinum, and General

Exploration Orange Free State are two other holding companies under the administration of the Corporation. Owing to the setback in platinum, the immediate outlook for the former is not promising. The latter company did not retain a material interest in its off-shoot, Riebeeck Gold, but has retained the mining rights over the deeper reefs in this general area subject to certain provisos. This interest could prove of economic importance if there should be an increase in gold price.

General Mining may count itself fortunate in having these important holding companies under its wing for they add considerably to its strength in the field of mining-finance in the Union.

STILFONTEIN

Stilfontein, which was the first big mine to produce gold from the Vaal Reef of the Klerksdorp area in July 1952, is today one of the richest gold/uranium producers in the Union, with a mining area of over 5,220 claims which assures it of a long life. The working profit from gold operations rose by 50 per cent in 1957 to over £3,700,000 and is currently running at an annual rate of £4,500,000. Uranium and acid production contributed £417,000 after provision for loan redemption, compared with £171,000 in the previous year and is currently running at a higher rate. Partly as a result of the substantial improvement in profits and partly due to the fact that the bulk of the short-term loans had been repaid by end 1956, dividend declarations rose from 1s. 0d. per share in 1956 to 2s. 10½d. per share for 1957, the final in December being 1s. 10½d. per share.

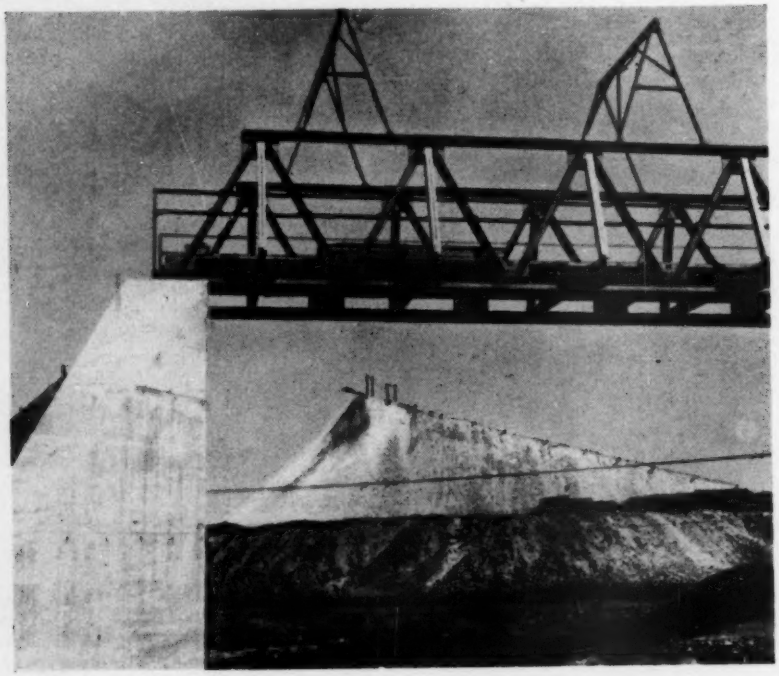
There was a further improvement in the volume and value of the ore reserves to a level of 4,361,000 tons at an average of 9.94 dwts. gold and 0.321 lbs. uranium oxide per ton over a stope width of 39.1 inches. This represents an increase of 75,000 tons and an improvement of 0.40 dwts. gold and 0.017 lbs. uranium per ton. The tonnage of the payable reserves is computed in terms of their gold content, without regard for their uranium content. As payability in development is consistently running in the neighbourhood of 90 per cent, any tonnage mined from outside the reserves as a result of proving to be payable on a combination of the gold and uranium content, is however likely to be relatively unimportant. The comparatively narrow stope width allied with waste sorting on the surface of the order of 24 per cent assures a high recovery grade. Indeed the recovery grade now exceeds the average value of the ore reserves due to this intensive sorting.

Development of the mine is being carried on through the medium of two main shafts, and a series of minor shafts designed to give access to certain of the upper levels and to the eastern section of the mine. Development to date has been largely from the Charles shaft which has been completed to its final depth. Sinking of the Margaret shaft to its final depth was delayed until 1958 following the disclosure of good values in the eastern section of the Charles shaft area for which borehole indications were singularly lacking. The decision to defer sinking of the Margaret shaft during 1957 led to a material reduction in calls on profits to finance capital expenditure during that year, and was therefore partly responsible for the material improvement in dividend declarations. Sinking operations recommenced in the first quarter of 1958 and a Koepe Winder, which will provide additional hoisting capacity to meet the proposed increases in the scale of production, is being installed.

The nominal capacity of the reduction plant was increased to 115,000 tons a month towards the end of 1955 and is being gradually extended to an ultimate capacity of 150,000 tons per month. Milling is currently running at about 110,000 tons per month which is a considerable achievement if allowance is made for the elimination of almost 24 per cent of the ore mined due to sorting. Nevertheless, the very adequate level of the ore reserves suggests that output will show a steady increase as increased plant capacity becomes available, providing the labour supply is relatively adequate. Apart from the gold plant treating ore only from the mine itself, there is a large uranium oxide extraction plant treating the residue gold slimes not only from Stilfontein, but also from the nearby Ellaton, Babrosco, Afrikander Lease and New Klerksdorp mines. Stilfontein also operates for its own account a contact acid plant with a capacity of 225 tons per day, the sulphuric acid being used in the extraction of uranium oxide by Stilfontein and nearby mines.

The marked improvement in gold profits during 1957 was largely due to an increase in the recovery grade from a level of 8.2 dwts. per ton in the last quarter of 1956 to 9.8 dwts. per ton in the December quarter of 1957. A contributory factor was the increase in production from 1,079,000 tons in 1956 to 1,231,000 tons for 1957. In the earlier years an undue proportion of the mining was of necessity concentrated in the relatively low grade stopes near the Charles Shaft. The improvement in the recovery grade in the past year suggests that the opening up of additional stope faces has now reached a stage when mining can be carried on more in accord with the average run of mine values. The further improvement in the gold content of the reserves indicates scope for a further modest improvement in recovery grade and there is of course the fact that output is to be stepped up materially in the next year or two to keep pace with planned extensions to the plant. There is thus scope for a further large increase in gold profits in the years immediately ahead. Conversely, profits from uranium production seem unlikely to show any further material improvement in the foreseeable future as there has been no indication of any worthwhile improvement in the relatively low uranium content of the reef; nor have plans been announced regarding an extension to the uranium plant. Nevertheless, such production should continue to make a useful contribution to profits during the currency of the present contract which runs until end 1964. Thereafter there is perhaps a fair prospect that uranium production will continue to prove economic because, as a by-product of gold operations, the only costs borne by uranium are those incurred in extracting the oxide from the residue gold slimes. This should go far towards offsetting the low grade.

With earnings currently running at an annual rate of over 8s. 0d. per share, there should be no difficulty in maintaining dividends at 1s. 10½d. per half year as this would leave over fully £2,500,000 for capital expenditure in a full year before allowing for further increases in profits. Moreover, bearing in mind the probability of such increases, there would seem to be no good reason to expect a reduction in the dividend rate when liability for taxation is incurred in a year or two's time. Stilfontein should be a sheet anchor in the General Mining portfolio for many years to come.



The West Reduction plant at West Rand Consolidated. The mine railway bridge to the stockpile

BUFFELSFONTEIN

For Buffelsfontein, situated to the south of Stilfontein and east of Hartebeestfontein, 1957 was an outstanding year. Gold production started in January with a record maiden profit declaration and throughput of £60,261 from the treatment of 80,000 tons of ore. Considering the depth of the reef, the achievement of bringing the mine to production at such a high initial rate of output within a period of three years and three months of the start of work on the property, is as impressive as the very rapid progress made in bringing the neighbouring Hartebeestfontein mine to production. The achievement is even more impressive when it is recorded that output was built up within four months to the full rated capacity of the mill (100,000 tons per month) and that milling averaged more than 110,000 tons per month in the last half of 1957. During the first year of underground development to June 30, 1957 and in spite of the high milling rate, an ore reserve of 1,157,000 tons averaging 7.45 dwts. gold and 0.579 lbs. uranium oxide per ton over a stoping width of 59.5 inches, was built up. Uranium production started on July 1, 1957, and the acid and pyrite plants started up in September, so that all the major installations of the company were producing at their full capacity before the end of 1957.

The property, consisting of 4,889 claims, is being developed from twin shafts which have been completed to their final depths of approximately 5,200 ft. and have a total hoisting capacity of 170,000 tons per month. The hoisting capacity is to be increased by re-equipping the Ventilation shaft with a 5,000 h.p. winder. This is necessary because the capacity of the reduction plant is being increased to 150,000 tons per month; simultaneously, the uranium plant capacity will be enlarged to 130,000 tons per month and the acid plant's output is to be stepped up from 100 tons to 250 tons per day. These extensions should be completed during the latter half of 1958 and denote an exceptionally rapid build-up in output. This is assisted by the width of the reef which until recently, exceeded the stoping widths at the neighbouring Stilfontein and Hartebeestfontein mines. Not only has this meant a stoping width of roughly 50 per cent greater than at its neighbours, but also that there is less scope for sorting. Consequently, Buffelsfontein has resorted to a high rate of milling to achieve its outstanding results and conversely, the recovery grade per ton is considerably lower than at its sister mines although development measured in inch dwts. and inch lbs. has been much on a par and even better than at the other two mines. Development in the second half of 1957 reflected some narrowing in the reef and the Chairman disclosed at the last annual meeting that the width was expected to decrease as development proceeded eastward. In time there should thus be prospects of some decrease in the stoping width and increase in sorting with a beneficial effect on recovery grades.

The rapid build-up in output has been accompanied by a similar trend in profits which in the December quarter of 1957 were £534,000 from gold and £321,000 from uranium and acid, the latter figure being after provision for loan redemption and interest. This permitted the declaration of a maiden dividend of 1s. 6d. per share in December whilst still retaining some £1,500,000 of the profits earned during 1957 to finance gold loan repayments and capital expenditure from profits. Capital expenditure during the current year is estimated at approximately £4,000,000, of which £500,000 is to be raised by a mortgage on the European Housing. Arrangements have also been made for short-term borrowings and the financial position has been improved by the extended repayment terms arranged in respect of the Anglo American loan of £2,500,000. These arrangements will even out the rate of appropriations from profits and permit of the maintenance of suitable dividends with the prospect of a material improvement in the position when the plant extensions become operative towards the end of 1958 or early 1959.

The uranium plant was formally opened on October 8th by their Excellencies, the High Commissioner for the United Kingdom and the Ambassador for the United States. The date chosen was the fifth anniversary of the opening of the first plant at West Rand Consolidated under the ten year programme. As Buffelsfontein was the last company to be admitted to this programme, the ceremonial opening was treated as an opportunity of paying tribute to these two countries for the part they have played in the establishment of a uranium industry in the Union. Although the uranium content of the reef at Buffelsfontein is not as high as that at West Rand Consolidated, it has the advantage of being a by-product of a highly payable gold reef and there is every prospect that production will continue to be economic after the expiry of the contract.

WEST RAND CONSOLIDATED

West Rand Consolidated, which started production as long ago as 1908 and thus celebrates its 50th anniversary as a producer this year, is today a predominently uranium producer. During 1957 operations in the gold section of the plant were marginal and there would seem to be little prospect of a worthwhile improvement in outlook, failing an increase in gold price. Nevertheless, ore reserves at December 31, 1957, although some 700,000 tons down on the previous year's figure, are still substantial being 5,264,000 tons, averaging 3.4 dwts. per ton over 50 inches. During the 50 years of its life, over 70,000,000 tons of ore have been treated for gold recovery; and throughout this period the working costs have been amongst the lowest in the industry. In 1956 working costs in the gold section averaged 33s. 1d. and for the mine as a whole 34s. 11d. per ton milled, compared with an average for the industry of 42s. 11d. per ton milled.

In the uranium section, a far brighter position exists and operations are maintained at full capacity. The ten year contract expires on December 31, 1964, and no difficulty is anticipated in maintaining the current rate of output to the end of the contract period. In direct contrast to the gold section, the uranium section is virtually a new mine and when the contract ends, with the loans fully redeemed and with four reef zones providing payable ore, the mine should be very well placed to compete in the supply of uranium oxide for very many years thereafter. The ore reserve in this section at December 31, 1957, was slightly higher in volume and value at 3,502,000 tons averaging 1.312 lbs. uranium and 0.8 dwts. gold per ton over a stoping width of 34 inches. This is sufficient to supply the mill for four years at the present rate of output and indicates that the present scale of profits should be well maintained. The uranium working profit in 1957 totalled £2,537,000 from the treatment of 900,000 tons of ore, compared with a working profit of £2,560,000 in 1956. Taxation was fractionally higher at £1,060,000 and with gold contributing less than in the previous year, the net profits available for distribution were rather lower than in 1956, but nevertheless sufficient to cover comfortably distributions on the Ordinaries totalling 4s. 3d. per share, an increase of 3d. The balance outstanding on the uranium loan at December 31, 1957 was £1,585,000.

Working costs in the uranium section are currently running at about 38s. per ton excluding uranium recovery costs but including normal crushing, milling and cyaniding. Approximately 0.6 dwts. gold is recovered from the ore, which at current price brings in a revenue of about 7s. 6d. per ton thus reducing the cost, in effect, to about 30s. 6d. per ton milled. Recovery is averaging about 1.40 lbs. uranium oxide per ton, so that the cost of production per lb. of contained uranium oxide may be estimated at rather less than 22s. plus uranium extraction costs. Although a full picture cannot be obtained because of the secrecy surrounding the cost of production, this estimate clearly indicates that West Rand Consolidated should be strongly placed even when the present contract expires. And the ordinary gold mining operations would receive a fresh lease of life in the event of an increase in gold price.

SOUTH ROODEPOORT

South Roodepoort is an unusual mine in that it is only entitled to mine the upper reefs—the Elsburg and Ventersdorp Contact series—in the 2,202 claims forming its mining property. The rights to mine the deeper reefs are held by the Johannesburg Consolidated Investment Co., subject to certain participation rights in favour of South Roodepoort. The life of the mine is somewhat problematical owing to its isolated situation, but results continue to be well maintained. The ore reserve at June 30, 1957 showed a slight improvement in quantity and value at 1,125,000 tons averaging 4.9 dwts. over 46 inches. The net profit after tax during the calendar year 1957 showed little variation, and dividends were comfortably maintained at 2s. 3d. per share. There has been some falling off in percentage payability in development, but this is compensated to some extent by rather higher values.

CONCLUSION

General Mining is fortunate in having under its control two such promising gold/uranium producers as Stilfontein and Buffelsfontein, with many years of profitable production ahead of them. Its substantial investments in Free State Geduld (Anglo American Group) and Hartebeestfontein (Anglo Transvaal Group) are equally promising; and its very large holding in the new Riebeeck mine (Anglo Transvaal Group) adds an interesting speculative flavour to a sound growth portfolio. Shareholders should start to reap the benefits of these predominant investments in new mining propositions in the course of the next year or two.

Anglo-Transvaal Consolidated Investment Co. Ltd.

THE Anglo-Transvaal Consolidated Investment Co.—more popularly known in Rand mining circles as "Anglovaal"—will, during 1957-58, be operating in the twenty-fifth year of its history.

During the past quarter of a century enormous growth has been achieved by this organization and Anglovaal is, in its own right, ranked as being among the major South African mining finance houses. Right from the start it has been basic policy at Anglovaal for the more stable continuing sources of income to be built up although at times when market conditions have been favourable it has gained from the realization of investments.

The present position of Anglovaal depends, as it always has, predominantly on the group's South African gold mining interest mainly in the Western Rand and in the Orange Free State. But there are important base-metal and industrial undertakings in the group for which Anglovaal acts as secretaries and managers besides having a substantial investment stake therein.

But of all the major companies in the Anglovaal stable it is Hartebeestfontein Gold Mining in the Klerksdorp district of the Far West Rand, which has become the group's biggest profit-earner and dividend-payer in the past two years and which will for the present be most immediately associated with Anglovaal. The technical achievements of Hartebeestfontein have paid off handsomely and have, indeed, become almost legendary in South African mining history during the past five years or so.

Shaft sinking at this 4,911 claim proposition did not start until the beginning of 1953 and work on the gold extraction plant was put in hand in August the following year. Yet official production of gold began as soon as July, 1955, there being a maiden working profit in that month of £58,000 from the milling of 44,000 tons of ore. A lot of pulp has travelled down the launders since that time. Uranium production officially started in November, by which time the ore tonnage had been gradually building up, and by the end of 1957 gold-uranium profits had jumped to the record level of £532,000 after allowing for loan repayments. Such progress for a large-scale mine is breath-taking and in the mining industry the fact has been quickly recognized.

However efficient it may be, no mine can achieve results of the Hartebeest calibre without the ore being there. The percentage payability at this mine in respect of the Vaal Reef, the sole ore-carrier, has always been high. In the year to June 30, 1956, it averaged 95 per cent and by that time ore reserves were estimated at 1,700,000 tons averaging 398 in.-dwt. Payability was substantially maintained during the ensuing year with ore reserves expanding to 2,100,000 tons averaging 394 in.-dwt. gold and 31.4 in.-lb. uranium.

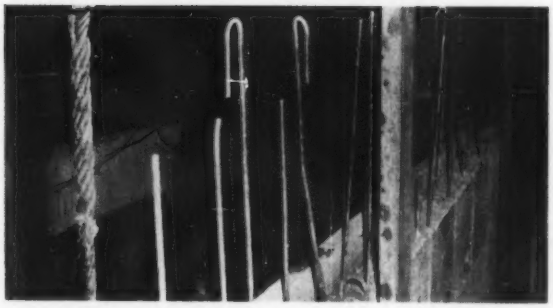
Waste sorting, both underground and on surface, is practised at Hartebeest on an intensive scale. This means that tonnage mined exceeds tonnage milled but avoids the expensive business of milling waste rock. Results have proved the system justified in lower mill costs and higher profits.

There is still a big capital expenditure programme ahead of the mine. To make available the deeper north-western section of the mine so that the milling rate can be stepped up to 100,000 tons a month, the hoisting capacity of the No. 2 shaft is being increased and the new No. 3 shaft has passed a depth of 2,000 ft. from surface. Altogether the programme is estimated to cost £6,000,000 over four years. The balance of loan to Anglo American Corporation of £1,600,000 will be repaid by the middle of 1961. But such is the present level of profits, now at £6,500,000, that these calls can be met and good dividends continue. For the year to June 30, 1957, there were two payments of 1s. 6d. and 2s. 6d. per share and so far for the current year there has been an increase to 3s. in the half-yearly payment.

The policy appears to have been to set dividends at a rate that can be maintained to allow for the replacement of capital expenditure by taxation when that stage is reached.

Gold mining can be a fickle master. In the same Anglovaal group the unfortunate Merriespruit in the Orange Free State, which by this time should have been earning steady profits is still flooded. The de-watering of the mine is to be achieved by driving haulages from the neighbouring Virginia Mine which is also in the Anglovaal group. The question at Merriespruit has now become one of patience. The de-watering haulages from Virginia into Merriespruit have themselves been held back from time to time by water troubles but are now back into the Merriespruit property. There is still 9,000 ft. to go but it is difficult to forecast when actual pumping through Virginia will be possible, although something should happen in this direction before another edition of this Annual is published. This, the first stage of the programme, will be completed at an estimated cost of £1,200,000. A second stage envisages the return of

It is proposed to open up the Zandpan Mining Area by a shaft sited S.W. of borehole T.L.40. Above, the scene looking north towards T.L.40, showing the area of the proposed site. Below, the surface area at No. 1 Shaft at Hartebeestfontein. Considered in conjunction, these two photographs show the tremendous surface construction necessary for a modern large tonnage gold mine. The Hartebeestfontein mine adjoins the Zandpan Mining Area



At left is the brattice wall dividing the 26ft. dia. circular shaft at Riebeeck into two sections. The smaller section will be used for upcast ventilation and the larger for downcast. The concrete brattice wall is being cast concurrently with sinking operations. Below is the No. 1 Shaft at Riebeeck Mine. The circular shaft will ultimately reach a depth of 5,800ft.

limited production and further development to permit the resumption of production at the normal level.

The Virginia Mine itself has continued to do reasonably well, although unexpected capital expenditure to offset water difficulties and prior claims of loan capital have kept it out of the dividend list. During the past year there has been a noticeable speeding up in development. Average payability is now about 49 per cent but the gold value of the payable footage is slightly higher. Development to the north of No. 1 shaft has shown an improvement in percentage payability and in assay values for gold and uranium as well as a slight increase in the average channel width. The average stoping width is now 52.6 in. At present, Virginia's mill capacity is around 130,000 tons monthly, but a target of 150,000 tons monthly is ultimately aimed at. The capacity of the sulphuric acid plant has also been increased (at the request of other producers of uranium) and is now supplying 370 tons of acid per day on regular contracts. Uranium and sulphuric acid production at Virginia is currently accounting for a large percentage of total profits which, in the December quarter of 1957, came out at £480,000 after tax, lease and loan repayments. Earnings during the whole of 1957 appeared equal to about 3s. 3d. per share against 2s. 9d. in the previous year.

Among Anglovaal's more recent ventures has been the flotation of Riebeeck, the latest of the newcomers to the Orange Free State whose property is the former Van den Heversrust area south of Loraine and northwest of Freddies where drilling in the past few years produced a series of exceptional results from a series of upper reefs lying above the normal Basal and Leader reef formations.

The drills on what is now the Riebeeck property usually spaced closely together, provided a geological picture of a whole series of new reefs altogether occurring in the Elsburg series which lie above the Basal-Leader reef horizons. Riebeeck has been duly floated but it will be still some time before shareholders will be able to obtain a fair idea of the chances of the property.

The immediate programme has been arranged with the neighbouring Loraine Mine from which Riebeeck will be provided with the second statutory outlet by twin crosscuts on the 4,800 ft. level. Meanwhile, Riebeeck itself is in the throes of shaft-sinking and not much during the current year should be looked for until the shaft enters the zones where Reef is likely to be encountered.

Capital expenditure at Riebeeck by the end of last year had totalled about £2,000,000. Sinking of the shaft is expected to be completed by the middle of next year.

Anglovaal is also responsible for Associated Manganese Mines of South Africa and Consolidated Murchison, these companies being respectively producers of manganese and antimony. Both of these undertakings have suffered from the general setback in base metal prices. During the current year Associated Manganese has reduced its interim dividend and the same is true of Consolidated Murchison. Both mines in recent times have been among the largest gross dividend payers in the Anglovaal group and their experience during the past year has been no more severe than might have been expected in the light of base metal mining conditions throughout the world. The position of Associated Manganese has always been aggravated by the shortage of railway trucks to move the material in South Africa to the coast and this factor is still a handicap. Both companies could well, with any sustained revival of economic activity in America and Europe, see a quickly improved offtake for their products.

If there has been any concentration on Anglovaal's mining activities in this review of its affairs, the reason is that this annual review of the *Mining Journal* is basically concerned with mining matters. On the other hand, Anglovaal's industrial interests are widespread and with the growth of secondary industry in South Africa must develop still further. These Anglovaal interests include investment in and the management of cement factories, a ferro-manganese smelter, four glass bottle factories, structural engineering works, a nut and bolt factory, fish trawling and distribution and the processing of fish by-products and a coastal engineering and shipbuilding yard. These industrial interests give the holder of Anglovaal shares a stake in a wide field of South African industry as well as in gold, coal and base-metal mining.

The parent company's revenue comes principally from fees and investments and other cources of a similar repeating nature. Net revenue in 1948 was £124,000 in respect of interest, commissions, fees, etc., but by 1957 it had steadily advanced to £490,000. Similarly dividend income over the same period has risen from £105,000 to what must be a record of £484,000 last year. During the same ten years investment profits had dropped from £784,000 to £112,000 last year, yet over the whole period investment income has actually improved from just over £1,000,000 to £1,100,000. For this reason, if no other, the investment status of Anglovaal shares is now strong.

Johannesburg Consolidated Investment Co. Ltd.

DURING the financial year which ended on June 30, 1957, Johannesburg Consolidated Investment was still deriving dividends from its numerous interests in respect of periods which were relatively prosperous. The platinum mining industry continued to increase payments to its shareholders and copper dividends flowing into the company's accounts were still on a rising curve. The result was that dividends received rose further from £1,860,000 in 1955-56 to £2,080,000 in 1956-57. Profits on sales of investments were more than maintained, and, in spite of a reduction in sundry revenue total income expanded from £2,290,000 to £2,470,000 after allowing for administration expenditure and loan stock interest. In 1954-55 the company had elected to have its investments valued for tax purposes as individual items instead of collectively, and this threw up substantial tax losses which greatly benefited the final results for that and the subsequent year. By 1956-57, however, most of this tax advantage had already been brought into account, and for that year it was necessary to provide in all some £871,000 for tax in contrast with the £105,000 required in the previous year. Net profit in consequence was reduced from £2,190,000 to £1,600,000, but the lower figure provided rather more than two-fold cover for an increased dividend of 5s. per share and permitted the transfer of £800,000 to investment reserve, leaving that account at £1,000,000 after deducting £300,000 required to adjust investment values to the lowest of cost, Stock Exchange value or directors' valuation in the case of quoted investments and to the lower of cost or directors' valuation in the case of unquoted investments.

During the year the company invested an additional £1,940,000 net, and the book value of quoted investments was raised from £11,070,000 to £11,930,000 and of unquoted holdings from £1,660,000 to £2,440,000. The behaviour of the various investments in the market varied considerably during the period, but on the whole was favourable, the market value of the quoted stocks rising by £1,150,000 compared with the increase of £861,000 in the book figure. In part due to the heavy new investment, net current assets were run down from £1,723,000 to £669,000, but the net worth of shareholders' interest, taking investments at market values, rose from £21,400,000 to £22,100,000, the net asset value of the shares thus being 84s.

THE PLATINUM INDUSTRY

The companies in which Johannesburg Consolidated is substantially interested produce about a dozen different minerals, including gold, uranium, platinum, diamonds, coal, copper, antimony, manganese, chrome, lead and zinc, and in addition there are industrial products, the most important of which is beer. The relative importance of these various products to the profit and loss account cannot be assessed accurately, but little doubt exists that platinum is one of the more important. The group's participation in this metal is held through Potgietersrust Platinums, which in turn owns 376,250 shares of Rustenburg Platinum Mines, equivalent to 43.32 per cent of the capital of that company. Johannesburg Consolidated is responsible for the management of Rustenburg and has derived an increasing revenue from its indirect shareholding in the company over recent years. Since 1949, when the undertaking belonging to the Union Platinum company was acquired and South African production of the metal was concentrated into a single unit, Rustenburg has engaged in three major expansion schemes in an effort to meet the actual and anticipated demand. The second of these became effective at the end of 1956 and the third was well on the way to completion at that time. With the second scheme operative for a major part of the year Rustenburg was able to secure larger profits in the year which ended on August 31, 1957, and the total dividend was raised from 40s. to 44s. per share, Potgietersrust Platinums thus being enabled to increase its own payment from 1s. 2s. to 1s. 3d. per share.

The post-war surge in demand for platinum arises mainly from competition in the motor industry to raise car performance by increasing compression ratios. This in turn requires fuels of higher octane (anti-knock), rating than were previously available, and the principal methods of producing these fuels employ platinum as a catalyst in what is known as "platforming." Though there is little actual loss of platinum in the process, Rustenburg was able, until the early part of 1957, to look forward to a rising demand for the metal as a result of the planned construction of platforming plants throughout the world, and its own expansion plans were based on the obligation, as one of the Free World's principal suppliers, to meet this demand at a reasonable price. By mid-1957, however, it became apparent that a major technical advance by the oil industry had altered the picture. A considerable reduction (some reports suggest as much as 50 per cent) was achieved in the quantity of platinum needed per barrel of installed capacity, with the result that, not only has the potential demand for the metal been reduced, but some of the leading oil companies have been able to cease buying it for a period while they use up accumulated stocks. The probability, therefore, is that the industry is at the moment passing through a period of sub-normal demand, but any assessment of the future must recognize that, while the prospect is that demand for high octane fuels will continue to rise, research could reduce still further the amount of platinum required in the process, and even that some other material with equal properties may be discovered.

One other factor equally difficult to assess is the potential supply of Russian metal. There are no figures relating to Russian output or exportable surplus, but it is clear that that country was able to sell overseas considerably greater quantities in 1955, 1956 and the early part of 1957 than in the two preceding years and that it was content to accept prices lower than the stabilized levels at which Rustenburg and International Nickel marketed their metal. By October, 1957, Rustenburg was compelled to reduce its selling price by £3 an oz. to approximately £31, and since then further cuts have been made to a current end-April level of £25 15s. 0d.-£26 15s. 0d. an oz. Moreover sales during the first four months of the present financial year fell to about 50 per cent of the average monthly sales in 1956-57, and it has been necessary not only to cease all but unavoidable work on the 1956-57 expansion plan but also to defer commissioning the new reduction plant installed as part of that plan and to cut back production. By this means a balance between supply and demand should ultimately be achieved, but the probability is that the company's stocks of metal will increase this year and that temporary finance will be required to carry them. Consequent on this change in the financial outlook the usual interim dividend payment in February, 1958, was omitted.

The accounts of Johannesburg Consolidated for 1956-57 included dividends from Potgietersrust Platinums totalling 1s. 2½d. per share compared with 1s. 1d. in the previous year. Into the current year's accounts will come only the final dividend of 9½d. paid by Potgietersrust in September last, but the full impact of the marked change in the platinum situation may not be felt until next year.

GOLD AND URANIUM

The group of gold mines long associated with the name of Johnnies has become attenuated with the passage of time, and for all practical purposes the only one which now rates as important, at least as far as dividend-paying ability is concerned, is Randfontein, which is strictly an uranium mine with gold as a by-product. Randfontein is the largest uranium mine in South Africa, obtaining the nuclear material from the Bird Reef series. Development of these reefs is concentrated in the northern part of the mine, where values have so far proved to be higher, and a yield of just over 1 lb. per ton is obtained. The quantity of ore available should last beyond the end of the contract period on December 31, 1964, but its profitability after that date will, of course, depend on the price which can be obtained for uranium oxide when the present contract expires. It has been disclosed that a rise in the gold price during the current contract period would not make a great deal of difference to net profits from the gold-uranium plant because the price paid by the U.K. and the U.S.A. for uranium is related to cost of production, and in the case of Randfontein cost is reckoned as outgoings less income from by-product gold. A higher gold price would improve the position of the gold division (as distinct from the gold-uranium section), by bringing back into the payable zone some lower grade ore, but without some development of this kind mining for gold alone on the Main reef series will be short-lived and of negligible importance. Up to the end of 1956 amortization of uranium plant expenditure kept the company virtually free of taxation in recent years, but this item absorbed over 15 per cent of profits in 1957, and the indications are that the proportion will rise over the next few years. The impact of taxation compelled the company to reduce its dividend from a peak of 5s. for 1956 to 4s. 6d. last year; the same cause may mean that a further reduction will have to be made this year.

Another important interest of the group in gold-uranium mining is Freddies Consolidated Mines, operating in the O.F.S. Moderate values and faulting, coupled with dilution of the ore by soft overlying shale, have made it impossible for this mine to earn more than very small profits, all of which have been absorbed in furthering development. Work is now concentrated in the northern section of the property, and certain of the company's assets including some 1,300 claims and No. 2 south shaft were sold to Free State Geduld in 1955 for 300,000 shares in that company. Heavy expenditure necessitated large sales from

that holding in 1955 and smaller sales in 1956, by the end of which year it had been reduced to 68,500 shares. This total was maintained in 1957, but significantly sales were resumed in the first quarter of 1957. In 1956 Johannesburg Consolidated reported that it held nearly 7,500,000 shares in the company, and it is unlikely that any major change has occurred since then. The prospect that the investment will ever yield dividends is slight, and it cannot therefore be taken into account in any assessment of future revenue of the holding company. Johannesburg Consolidated has a further indirect interest in this situation through Free State Development and Investment and that company has a 20 per cent participation in the project south of Randfontein to which reference is made below.

In the distant past the Johnnies group played an important part in opening up the eastern part of the Rand, but the mines which it established there have now ceased to yield income for the parent company. Government Gold Mining Areas gave statutory notice of closure in March, 1957, and is now engaged on reclamation of such ore as will yield a profit. The main source of income, however, is derived from the operation of a plant producing pyrite concentrates. Future distributions are likely to be in whole or in part by way of capital return. New State Areas and Witwatersrand Gold are in process of realizing their assets after long and highly successful careers as gold mines. The remaining member of the group's gold-uranium mines is East Champ d'Or, which is operating a comparatively small claim area for uranium, the slimes being treated at the Randfontein plant. Primary development has been virtually completed, and it is officially regarded as unlikely that the remaining ore will last out the life of the uranium contract, which is due to end on December 31, 1964. Dividends were reduced from 10d. for 1956 to 7d. per share for 1957, and can only continue for a further short period. In the event of ore supplies failing before the end of 1964 the company's quota will be taken up by Randfontein, but as East Champ d'Or is currently milling only about 12,000 tons of ore per month, this will not make much difference to the larger mine.

Over a period of several years Johannesburg Consolidated carried out extensive prospecting of a large area some 18 miles to the south of the Randfontein mine, and in all sank 33 boreholes, of which 24 intersected one or more reefs of the Upper Elsburg and Ventersdorp Contact series. Of these 24 holes, 16 gave economic values, but within the total are it was possible to define a compact area which included all these 16 holes, and it is estimated that this defined section contains 68,000,000 tons of ore likely to be payable under present conditions. Most of it (some 50,000,000 tons) consists of Upper Elsburg ore worth about 8.5 dwt. per ton and the remainder is of somewhat higher grade, and an overall recovery of 5½-6 dwt. is considered possible. The reefs are of a considerable thickness and a large proportion of the tonnage lies at a depth of not more than 4,600 ft. below surface. No great mining difficulties should therefore arise and selective mining should be possible, giving perhaps an operating profit in the region of 20s.-30s. per ton milled, but in view of the heavy capital expenditure and other factors involved it has been decided to defer exploitation of the property for the present. The project is, however, one which seems likely to yield a useful profit at some future time.

DIAMONDS—COPPER—MANGANESE

Though it has no direct management interest in the industry, the name of Johnnies has long been associated with diamond mining, its participation being mainly via a large shareholding in De Beers. This holding has yielded a steady revenue over recent years, and De Beers has of course greatly expanded its interests beyond the diamond industry giving it a broader and sounder base than formerly. The industry as a whole was achieving new sales records until the latter part of last year and it is still highly prosperous, but there have been recent signs that demand for industrial qualities may have fallen below production levels, and that the reduced momentum of the American economy is beginning to have some effect on buying of gem stones. Johnnies should nevertheless be able to look forward to a maintenance of its income from this source.

The same does not apply to its important participation in the copper mining industry of Northern Rhodesia through shareholdings in Rhokana, Nchanga and Rhodesian Anglo American. Broadly dividend receipts from this source were still rising during the year to June 30, 1957, but subsequent payments by these companies suggest that there will be an appreciable reduction in this income in 1957-58.

The interest in manganese is comparatively recent and stems from the acquisition of a large shareholding in S.A. Minerals Corporation in September, 1956, at which time the company came under the technical management of Johnnies. S.A. Minerals derives the greater part of its income from a manganese mine some 250 miles north-east of the port of Walvis Bay, but also owns a chrome mine 40 miles from Rustenburg. It has resumed ordinary dividend payment during Johnnies' current financial year. Johannesburg Consolidated is also responsible for the technical management of, and has a share interest in, Consolidated Murchison (Transvaal) Goldfields and Development, which is mainly a producer of antimony, and it is concerned to a small extent with the future of lead and zinc through the ownership of the entire capital of Llanrwst Lead Mines, which owns a mine in North Wales.

Most important of the industrial companies in which Johnnies is interested is South African Breweries, into which the greater part of the brewing trade in the Union and Rhodesia is now concentrated. The benefits of the merger with the other principal companies in the business should become increasingly apparent in the years to come and should offset the long-term trend for beer consumption to fall. The group is also concerned in the engineering trade through J.C.I. General Engineering, which operates from Kroonstad, O.F.S., and is engaged in the fabrication of steel, and sales for the mining and other industries. Louw's Creek Mining Timber (Pty.), which became a wholly-owned subsidiary in 1956, is producing timber from leased lands in the Eastern Transvaal.

NEW CAPITAL

Additional capital has become available to the company during the current financial year as a result of a deal with New Rhodesia Investments in November, 1957. That company, in which the British South Africa Co. (Chartered) has a 50 per cent interest, subscribed for 600,000 Johnnies shares at 55s. per share. At the same time, Johnnies bought 250,000 Chartered ordinary stock units of 15s. each from New Rhodesia Investments at 58s. per stock unit. By the latter acquisition, the company increased its participation in the Rhodesian copper industry, but it also obtained a stake in the widespread activities of Chartered which include investment in numerous profitable enterprises and exploration work over large areas in Africa. The deal moreover resulted in the provision of £925,000 in cash for Johnnies which is to be utilized for the general purposes of the company and will enable it to continue spreading its investments over a broadening field.

It is apparent from the outline of events already given that income this year from some of the major investments, including particularly the platinum, copper and Randfontein holdings is likely to be at a lower rate than last year. Some of the new holdings acquired in 1956-57 did not, however, yield a full year's revenue, and there is another important factor which can have a marked effect on the results of any one year—the movement in prices of the group's investments. Though a need arises for writing down investments when market value falls below the book figure, there is an accompanying saving in taxation because the liability is now dependent on changes in the value of the portfolio. A number of the major shareholdings have declined substantially in market value since the 1956-57 accounts were made up, and it is therefore conceivable that the 1957-58 figures will benefit from tax reliefs on some part of this depreciation, and that this will keep the overall tax rate at a comparatively low level. Mr. D. A. B. Watson, who presided at the annual meeting in November last, was moreover hopeful that dividend income during the current year would be substantially maintained. Short-term fluctuations are inevitable in a portfolio which contains a large proportion of holdings subject to the vagaries of market prices for commodities, but, these immediate considerations apart, the group's interests are well spread to ensure a consistent return when averaged over a period.

MAP OF THE KLERKSDORP FIELD

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New Union Goldfields Ltd.

THE two years to June 1957 were difficult for all mining finance houses primarily interested in gold, and New Union Goldfields, with a portfolio of Kaffirs as its major source of income, was no exception. Indeed, the long bear market compelled the company to write off almost £700,000 from investment book values, while the sluggish conditions of this period made it almost impossible to pursue the normal finance house procedure of realizing shares to provide funds for new enterprises.

This inevitably led to strain on New Union's resources and the occasional necessity of finding new capital for expanding mines held as a portfolio investment or for New Union's own group of growing mines, aggravated the position. Thus, at June 30, 1957, New Union's reserves totalled £484,000 whereas at June 30, 1955, they amounted to £925,900. Nevertheless, there is credit in the fact that the rough passage was survived with a fall in reserves of only fifty per cent—there is no adverse balance on New Union's profit and loss account.

New Union's interests fall conveniently into two groups. Those companies to which New Union acts as managers, secretaries or consultants and secondly, portfolio investments. Several companies in the latter group are reviewed in detail in other pages of this section, and it is necessary only to say that, in general, the weight of New Union's holdings is concentrated on the young gold producers in the Orange Free State and in the Klerksdorp fields, either directly or through investment companies.

There is also a sprinkling of investments in a few selected South African Industrials and in Land and Estate Companies.

The list of companies actually administered by New Union is extremely diverse, ranging from reclamation mining on the Rand to seed growing and trading. The more important of these are summarized below:—

ANGLO-RAND MINING AND FINANCE CORPORATION, LTD.

This is a financial and exploration business. The portfolio includes shares in Winkelhaak Mines, as well as in associated companies of the New Union Group, while land-holdings include rights in the Kinross area of the Transvaal and over portions of the area covered by the "J.C.I. Western Areas Prospect," known to contain a considerable tonnage of medium grade gold ore.

BEATRICE GOLD MINING CO., LTD.

Beatrice Gold is another portfolio-holding and exploration company. A subsidiary holds a substantial block of Winkelhaak shares.

DOMINION REEFS (KLERKSDORP), LTD.

From its Uranium property in the Klerksdorp area, Dominion Reefs last year made a profit of £507,351. In 1957 the tax authorities reversed an earlier decision and ruled that the mine should again be treated as a gold mine for tax purposes. Dominion Reefs will now not, in fact, obtain the overall tax savings that had been hoped for earlier.

LYDENBURG GOLD FARMS CO., LTD.

A land and investment company, with chrome and other mineral rights in various parts of the Union, and a portfolio in which O.F.S. gold mines predominate. There is a substantial investment in Harmony.

NEW DURBAN GOLD AND INDUSTRIALS, LTD.

New Durban Gold owns, through a subsidiary, a township in the Borough of Durban. It also has a block of 1,000,000 shares in Natal Portland Cement.

NEW UNION GENERAL INDUSTRIES, LTD.

This company is one of the holding companies through which New Union Goldfields operates its industrial interests. The portfolio, valued at just under £285,000 last June, includes most of the industrial companies of the group.

NEW WITWATERSRAND GOLD EXPLORATION CO., LTD.

New Wits is a major finance and exploration company. Directly and through subsidiaries it controls a portfolio worth almost £1,750,000 (at June 30, 1957), including many of the O.F.S. and Klerksdorp gold producers and associated finance houses, as well as interests in coal and other minerals. Land holdings include areas in the West Rand, one of which will entitle New Wits to a one per cent interest in Western Deep Levels, and also an interest in the "J.C.I. Western Areas Prospect."

STAR DIAMONDS (PROPRIETARY) LTD.

Star Diamonds, a subsidiary of another group company (Selected Mining Holdings) made a profit of £38,956 from its O.F.S. property in 1957. Early in 1957, the mine was gazetted as a "large mine" and became liable to a fifty per cent State's share of profit, which, however, will only become payable after the not inconsiderable amount of capital expenditures will have been redeemed.

UNION TIN MINES, LTD.

Metallurgical difficulties caused a sharp fall in the rate of extraction at this property in 1957, causing a loss of £17,797. Results for the first few months of the 1958 year, showed a slight improvement, but the outlook for this particular investment is not promising.

VELLEFONTEIN TIN MINING CO., LTD.

A profit of £17,514 resulted from 1957 operations on this company's property in the Warmbaths area of the Transvaal.

WAVERLEY GOLD MINES, LTD.

Waverley operates a reclamation mine on part of the now defunct Knights property. In 1956 a minor portion of the mining area was sold to Primrose Gold Mining, in which Waverley now holds some 15 per cent of the issued capital. It also owns extensive mineral rights in the Transvaal, O.F.S. and Cape Province.

WITWATERSRAND DEEP, LTD.

Wit. Deep has several small land holdings, but its principal interest is a block of 67,500 shares held at par in the new Western Deep Levels flotation. In due course, a further 270,000 shares will be offered to the Wit. Deep company or its shareholders. If and when any of Western Deeps' "B" shares are issued, Wit. Deep will also be entitled to a proportion of these.

In addition to operations conducted through these associated companies, New Union is active in exploration on its own account. During most of the year ended June 30, 1957, activity in this field was concentrated on drilling a coal option, the Carolina Block, and a phosphorous pentoxide prospect at Glenover, Northern Transvaal. About 62,000,000 tons of good quality coal has been proved on the Carolina property, and accordingly New Union has exercised its option to purchase the coal rights over this and certain other untested properties, which will be prospected in due course.

At Glenover, a deposit has been proved with an estimated content of at least 2,000,000 tons of ore grading approximately 30 per cent phosphorous pentoxide. A five-year contract with African Metals Corporation will enable New Union to write off initial costs during the contract period, besides providing a fair margin of profit.

Thus the two branches of New Union's activities achieved diametrically opposite results in the 1957 financial year. Mining and exploration results were encouraging, but the financial out-turn was disappointing. It is apparent, nevertheless, that there has been no actual deterioration in the affairs of the company, but rather a slowing-down in the progress of rehabilitation.

Moreover, it may well be that the worst is now over. New Union's interest in the younger gold mines has meant that many calls have been made on capital, with little in the way of dividends as recompense. This position is now changing as dividend income begins to increase, and although the benefit will not be immediately felt by New Union (because of indirect holdings), the long-term trend must be upwards. New finance will not be needed so often either (although the Group is substantially committed in the developing Free State Saaiplaas mine), for the new townships and properties controlled by New Union are now in or are approaching the self-supporting stage. And thirdly, wilting markets over the past few years have absorbed so much by way of investment depreciation that running-down of reserves in the future will, if needed at all, be on a much smaller scale. There are sure to be further setbacks from time to time—this is in the essential nature of New Union's business—but even this year's results may well be decidedly better than those for 1957.

Anglo-French Exploration Co. Ltd.

Year to Dec. 31	Total Revenue £	Taxation £	Net Profit £	Dividends* £	To Reserve £	Carry Forward £
1957	160,732	79,571	50,014	48,516	Nil	8,011
1956	146,208	67,497	49,324	48,516	Nil	6,513
1955	137,277	59,056	45,509	45,281	Nil	5,705

* 1957: 9.375% on £900,000 capital; 1956 9.375%; 1955 8.75. %

THE Anglo-French Exploration Company holds an investment portfolio divided almost equally between gold shares and other investments. The company reduced its base metal holdings in 1957 but not substantially, although this may appear so in the accompanying table which is drawn up in terms of book values, because of the divergent price trends in 1957 as between gold shares and base metal shares.

The gold section of the portfolio is expansionist in character and the major part thereof is in the Far West-Rand and Orange Free State. It includes several of the important finance houses, and of the actual gold producers only three are pre-war mines, viz, Durban Deep, Vlakfontein and Venterspost. Thus the continuance of the upward trend of revenue (as shown in the accompanying table) seems assured.

The remaining fifty per cent of the company's portfolio consists of substantial holdings of oil and of copper/lead/zinc shares, with rather smaller interests in tin, platinum, coal and a miscellaneous group. Anglo-French acts as secretaries and agents to several of the mines in these groups, the most important of which are Apex Mines (coalmining, Transvaal), Rooiberg Minerals Development Co. (tin, Transvaal), Apex (Trinidad) Oilfields and Anglo-Burma Tin Co.

The writing down of investment book values was an experience shared by most companies last year and Anglo-French showed no deviation from the general trend; £10,307 of profits were absorbed in this way, leaving the total book value of the investments at £1,120,949 at the year end. This figure still represents an excess of market value over book value of over £300,000, which, in view of the bearish trend of markets generally, is by no means unsatisfactory. Equally satisfactory is the fact that approximately 95 per cent of Anglo-French's investments have a stock exchange quotation.

The constant expansion of Anglo-French's activities since the war has necessitated the raising of fresh capital by way of rights issues on several occasions, and the latest, made in April this year, brought the company's issued capital up to £1,000,000. Like its predecessor, this last issue, which was on the basis of £1 of new stock at par for every £9 held, was unusual in that it was not underwritten, and also like its predecessor was over-subscribed. This was to be expected, for at this year's meeting the chairman said that, save for any unforeseen circumstances, the dividend would be maintained at the rate of 1/10½d. per stock unit (9¼ per cent) on the capital as increased by the issue.

Year	Gold* %	Oil %	Copper† %	Coal %	Tin %	Platinum %	Other %
1957	53.6	22.9	7.0	8.8	4.1	1.8	1.8
1956	49.2	20.2	13.3	7.9	4.8	3.3	1.3
1955	52.7	18.8	13.6	7.4	3.9	2.5	1.1

*Including holding companies. †Copper, lead and zinc. Percentages are calculated on valuation.

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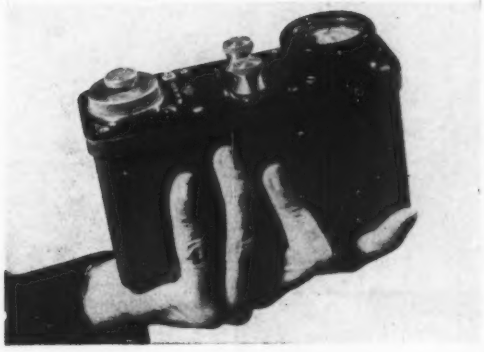

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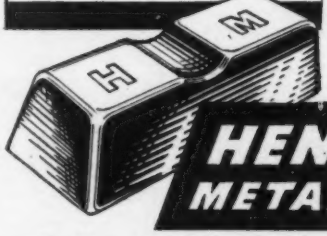

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East Rand Consolidated Ltd.

THE Company has had little fortune with its past flotations covering a large area adjoining the famous Sub Nigel and Vlakfontein mines, which have so sucessfully exploited the rich shoots running through the southern East Rand basin. All the flotations, with possibly the exception of Witwatersrand Nigel, have had to contend with thin and erratically distributed pay zones, which, even after the last increase in the price of gold, failed to provide sufficient tonnages for economic working of the deposits.

In this context, it is doubtful if the next increase, which many expect in the near future, will alter the position materially, and with this in mind it is understandable why the directors have endeavoured a reorientation of the Company's affairs.

In the first complete year following the capital reorganization carried out in November 1955, the Company was able to report a further useful increase in revenue of £71,392. With profits on the sale of investments rising by some £12,000 the net profit for the year 1956 improved to £58,237 enabling the Board to declare an initial dividend of 1½d. per share (6¼ per cent).

The pruning of interests on the unprofitable edge of the Far East Rand has reduced the gold mining content of the portfolio to just under 50 per cent. As a consequence the stake in base metals, oil, industrials and miscellaneous investments has risen to 22 per cent; the remainder of the funds being in mining exploration and finance companies.

The book value of the investments at the time of the report (May 1957) was £550,110, but owing to this date coinciding with what may have been the nadir of the long bear market in gold shares, the market value of £529,970 was less favourable than at the end of the financial year. However, some revival has taken place since the last accounts and the next report due shortly may well reflect this position.

WITWATERSRAND NIGEL LTD.

Situated on the southern rim of the East Rand basin, with the reefs dipping to the north, the Company is a comparatively small producer in relation to its large claim area.

Year to June 30	*Tons Milled* (000)	*Grade* (*dwt.*)	*Cost per ton* s.	d.	*Working Profit* £	*Capital Expend.* £	*Dividend* %	*Ore Reserves Tons* (000)	*Grade* (*dwt.*)
1957	214.7	4.46	48	2	85,528	117,392	—	785	5.1
1956	219.9	4.34	46	7	85,772	101,812	5	738	4.6
1955	214	4.45	46	6	105,639	101,607	5	779	4.6
1954	207.6	4.48	46	3	98,764	37,789	5	746	4.6
1953	202.4	4.51	47	8	100,041	33,495	—	729	4.4

Of the two separate sections, the Houtpoort shoot which is of slightly better grade is the larger source of ore. As a consequence the initial plant with a capacity of 10,000 tons per month was sited on this area, and recently a new shaft (No. 3) has been completed to 3,056 ft., to exploit this section more economically at depth.

The Poortje shoot some distance to the east had its own mill commissioned in 1952 with a capacity of 7,000 tons, and the resulting increase in total tonnage treated quadrupled the profits and enabled the commencement of modest payments of 5 per cent for the following three years; the capital requirements of the new Houtpoort shaft however has forced a temporary retirement for the time being.

Although the footage developed during the year ended June 30, 1957, was practically the same as in the previous year, payability improved slightly to 41 per cent. Values, on the other hand, showed a welcome spurt from 242 in. dwt. to 373 in. dwt. but this good fortune has not been fully maintained in the latest half year.

Development in the Houtpoort area continued on a reduced scale with little improvement in values; the substantial increase in grade being entirely due to good ore encountered in the Poortje section.

In No. 3 shaft the Main Reef was intersected at 3,053 ft. assaying 9.9 dwt. over 10.1 in. and in view of the shaft being sunk outside the known pay zone such a result may be considered encouraging. Following the connection between the bottom of this shaft and the inclined haulage advanced from No. 1 shaft, development in the deeper levels in the near future can be expected to throw a good deal of light on the life prospects of the mine.

Ore reserves after relapsing in 1955-56 have benefited from the improved development at Poortje and at 785,000 tons show an increase of 47,000 tons. The grade of 5.1 dwt. is also ½ dwt. better which shows reflection in the revenue return despite a slightly lower throughput.

With costs continuing their rise (up 1s. 7d. per ton) the resulting working profit remained virtually the same as the previous year. In the current year the grade of mill feed has improved further, but the additional revenue is not keeping pace with the increased development charge for the necessary work being done in the No. 3 shaft area.

The net profit at £91,685 shows a slight reduction, and with £100,000 appropriated for capital expenditure it is not surprising that no dividend was possible this time; net current assets are down to just under £10,000. With the heavy drain on resources abating however, it is expected that dividends on the previous scale can be resumed in the current year.

SPAARWATER GOLD MINING CO., LTD.

Unlike other Rand mining companies, Spaarwater is in fact if not in form an exploration company, its production statistics relating to operations at a pilot plant with a monthly capacity of 10,000 tons a month. The pilot plant treats ore exposed by development and thus provides funds to enable prospecting work to be carried out.

Milling began in 1947 and for some years development was confined to the area abutting on Sub Nigel ground. Recently, however, work has been directed towards exploring the western section of the mine. Success in this endeavour has been mixed but, on the whole, disappointing, and the prospect for establishing profitable production within the company's lease area is now considered to be slender.

During 1957, development in the western area of the mine gave 24.3 per cent payability and values of 257 in.-dwt. Development in a northerly direction encountered a downthrow fault beyond which the pay zone has not yet been located, while in a southerly direction development in this zone yielded progressively lower percentage payability.

All signs point to the company being thrown back on developing the ore in the known pay zones of the mine. If so, the probability is that development costs would be paid for by the discovery of new payable ore.

At the end of 1957 ore reserves fully developed based on a pay limit calculated to conform approximately to existing conditions was estimated at 267,000 tons averaging 5.9 dwt. per ton over a stoping width of 38 in.

WEST VLAKFONTEIN GOLD MINING CO., LTD.

West Vlakfontein sold its lease and plant to Vlakfontein Gold Mining Co. in November 1956 for the sum of £50,000 but retains a royalty interest in respect of the original lease area. This could be important should Vlakfontein Gold work the property, as West Vlakfontein would then receive 12s. 6d. for every square fathom of ground excavated. Meanwhile every effort is concentrated on converting the company into a successful mining finance house.

The position as at the end of May 1957 was that the company had acquired a 2¼ per cent interest in the "Waterpan Area," south of Ranfontein and a similar percentage over a large area in the Potchefstroom District lying to the northeast of the Hartebeestfontein and Buffelsfontein mines. The company also purchased an interest in the Rietkuil Mining Company which holds option and prospecting contracts over Block B 1 adjoining Afrikander Lease Limited.

In 1956 the company acquired options over 93,000 acres in the Kinross area but these were abadoned last year. However, West Vlakfontein has retained its shareholding in Winkelhaak Mines and investments at December 31, 1956, were recorded in the balance sheet at £115,645 with a market value of £100,702. Additionally, loans on call stood at £75,000 and cash at £37,000. As Mr. E. Jacobson, chairman, pointed out in his speech to shareholders in May 1957, a substantial portion of the company's funds have been retained in liquid form, although earning a reasonable rate of interest, so that advantage may be taken of any favourable opportunity for participating in any business that may be offered.

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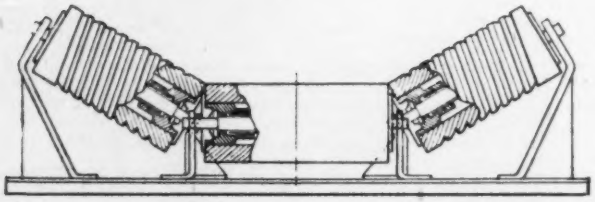

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Henderson's Transvaal Estates

Year to March 31.	1955	1956	1957
	£	£	£
Total Revenue	227,061	267,501	327,373
Taxation	70,950	86,423	111,792
Net Profit	67,082	76,290	77,156
Dividends	48,599	48,599	48,599
To Reserve	37,519	12,555	37,272
Carry Forward	171,992	182,981	168,440

ONE of the oldest of the South African Mining Houses, Henderson's Transvaal Estates, was formed in 1894 and assumed its present form in 1912 after a series of reorganizations. During that eighteen year period its land holdings and investments were built up to a level very similar to that of today, although it is only since the last war that earnings have begun to expand appreciably. This is no more than a tribute to the foresight of the early management, who, fifty years ago, had already acquired substantial land holdings in such "new" mining areas as the O.F.S., the Bethal Area and the Far East Rand Basin.

This is not to say, however, that Henderson's is in any way dependent on the expansion of the gold mining industry in the new fields. Throughout most of Henderson's long life coal has been the chief interest, reflected mainly through its subsidiary, Tweefontein United Collieries Ltd. Tweefontein is an old colliery—production began in 1907—but a large and still expanding one. In the financial year ended December 31, 1957, for example, Tweefontein's sales output amounted to 1,387,000 tons, compared with 1,280,000 four years earlier. A more marked expansion in sales has been prevented in recent years by the chronic shortage of rail facilities in the Union and also by serious seasonal shortages of native labour. Fortunately, it has been possible for Tweefontein to fight railway truck shortage by despatching coal by road and during the 1957 financial year no less than 465,000 tons of coal were moved by this method, equivalent to more than one-third of the company's total sales output.

Recently there has been a certain amount of exploratory development at the colliery's two sections, Waterpan and Tweefontein, which has led to two important conclusions—that the No. 1 seam, practically untouched at present, is an economic coal producer, and secondly, that proved and probable reserves at the property are ample for all future requirements. Although new labour regulations caused a drop in the 1956 output from the previous year's 1,352,000 tons, in 1957 this cut-back was more than made up and it is apparent from these facts that the future of Tweefontein is assured for many years to come, a conclusion borne out by the management's decision to carry out major renewals and the replacement of machinery, equipment and housing.

In the spring of 1957 it appeared for a time that there was a good chance of Tweefontein's profit potential being very rapidly augmented. Drilling operations had been carried on over a block of farms owned by the colliery, the so-called "Iron Farms" in the Middelburg district of the Transvaal, and it had been established that the area was underlain by very large tonnages of fair to good quality coal. Shortly after the drilling programme was completed, the Electricity Supply Commission put out invitations to tender for the supply of coal to a large new power station which it was proposed to erect in the Eastern Transvaal, the assumption being that the new station would be built on or adjacent to the successful tenderer's property. Heavy capital expenditure would have been necessary in the event of Tweefontein being selected, but the advantages to the company of an assured market with no transport problems are obvious. However, towards the end of the year it was made known that the Electricity Supply Commission had placed the contract elsewhere.

Another well established interest of Henderson's Transvaal Estates is the cement industry. The company's main stake in this field is through an undisclosed but certainly substantial unquoted shareholding in White's South African Portland Cement, Ltd., an old but progressive producer. Actual revenue accruing to Henderson's from this source is impossible to ascertain, but it is probable that a large proportion of the investment revenue shown in the table below is attributable to White's. The most recent example of this company's forward-looking policy was the acquisition in 1956 of a large participation in the Salisbury Portland Cement Company, a new flotation formed to produce cement in Rhodesia. The property owned by this company, which is estimated to contain sufficient limestone to provide an annual output of 130,000 tons for fifty years, was brought to production last year.

The other major branch of Henderson's activities is its holdings of land, mineral rights, and concessions. These are held through a subsidiary, Mineral Holdings, and, at the date of the last report and accounts, amounted to some 23,000 acres of freehold lands, mineral rights over a further 685,000 acres, and concessions on various areas in Swaziland totalling almost 753,000 acres. Potentially the most important of these are certain of the Swaziland holdings which are known to be underlain by substantial quantities of coal and iron ore.

At present exploitation of these areas is precluded by the total lack of rail facilities, but Sir Arthur Griffin, the well-known expert on transportation, has recently made a study of the Protectorate's old problem in its widest aspect, and his report is awaited with more than passing interest by the Henderson's company. Less is known about the remaining areas in Swaziland, and during the past year prospecting has been carried out by the Johannesburg Consolidated Investment Company (by arrangement with Henderson's) both by geophysical means and by bore-holes. No results are yet available.

Prospecting has also been carried out on some of the properties in the Union, partly under the supervision of Johannesburg Consolidated and partly under a similar option arrangement with New Consolidated Gold Fields. Again, no results are yet available. There are two other properties, however, the potential of which has recently been assessed.

The first of these is an area in the Free State adjoining the colliery of the Clydesdale (Transvaal) company. This property was under option to Clydesdale until the end of 1957, as it was not large enough to support an independent colliery operation. It is believed that the option was exercised although details will not be known until the annual report is published in June. An option that was definitely exercised was that held by Union Corporation over the farm Zandfontein in the Kinross-Bethal area. As well as the purchase price of £22 per morgen for the mineral rights, Mineral Holdings will, in due course, receive a proportion of the subscription rights, vendor consideration and underwriting of any company formed to exploit the area, which is near the developing Winkelhaak mine, also administered by Union Corporation.

The main change in Henderson's investment portfolio in the 1957 financial year was the selling of the company's holdings in certain South African mines, and the re-investment of the proceeds in other shares having better prospects of increasing rather than diminishing dividends. This operation resulted in a loss of £18,059, but the long-term advantage is self-evident.

There were no significant changes in Henderson's Consolidated balance sheet at March 31, 1957. The healthy liquid position was maintained, with current assets (including cash and short-term deposits of £473,000) exceeding liabilities by £412,000, while the excess of market over book value of the portfolio amounted to about £163,000.

On consolidated profit and loss account, net group profits were fractionally higher than in the previous year, allowing for an unchanged distribution of 15 per cent. The carry-forward, however, was reduced by an increase in the amount placed to reserve. The accounts are summarized in the two tables on this page.

Year to March 31.	1955	1956	1957
	£	£	£
Coal Profits*	141,915	146,949	236,654
Dividends and Sundries	737,700	73,598	91,062
Rents (net)	5,063	5,762	5,841
Royalties, etc.	4,287	2,034	1,666
Sharedealing	1,846	34,340	Dr. 13,555
Profit on Property Sales	250	4,818	5,705

* After working expenses including replacements, renewals and selling commission.

Messina (Transvaal) Development Co. Ltd.

DURING the past 18 months copper producers all over the world have been meeting sterner conditions than had been experienced for several years previously. With the continuing fall in the price of the metal, profit margins have been severely pruned and there has been more than one instance of a cutback in expansion and development programmes. Most of the important producers retain the view that on the long term copper will come back into its own, but for the present, earnings have come under considerable pressure and dividend distributions accordingly have had to be reduced.

The experience of Messina (Transvaal) Development during the past year has been no more than parallel with that reported by most other copper producers. Despite higher production, income on copper account in the year to September 30, 1957, fell from £4,300,000 to £3,600,000 and the year's taxed profits declined from £1,800,000 to £1,200,000. It was thus deemed necessary to cut the year's dividend distributions to a total of 220 per cent on the small issued capital of £330,000 in 5s. units compared with the 420 per cent paid in 1955-56 and 380 per cent in the year before that. It should be noted, however, that earnings last year were still equivalent to just over 350 per cent and that the company has therefore again adhered to its normal conservative distribution policy.

Messina is a company of long-standing history which until the post-war years had been largely dependent on its copper mines in the Northern Transvaal just south of the Southern Rhodesian border. Several new and important projects have been put in hand in recent years but it is still true to say that the company's earnings substantially depend on results obtained from the Campbell, Harper, Messina and Artonvilla mines in the Transvaal.

It has been part of Messina's mining policy in recent years to maximize as far as possible the exploitation of comparatively low grade ore, and in consequence there has been a steady decline in the average grade treated. This process continued last year so that although production was higher, the lower grade of ore treated had the effect of increasing the cost of refined copper to £130 per l.ton compared with £119 in the previous year. The point is to be made that even with a reduction in the grade milled, Messina has still been able to remain an extremely viable proposition and could, it would appear, continue comfortably in operation even if the price of copper should suffer a further decline. It follows that earnings of this low-cost producer from its Transvaal operations would, in percentage terms on the small issued capital, sharply rebound with only a comparatively modest recovery in the copper price.

No review of Messina's prospect however, starts and finishes nowadays with its old Transvaal mines. As we have said, these continue to provide the backbone of earnings and are likely to for some time ahead. But in recent years Messina has been expanding fast in other directions. In last year's review we referred at length to the position and progress of M.T.D. (Mangula), a Southern Rhodesian copper operation in which Messina had an 84 per cent interest. The past year has seen the public flotation of Mangula and this company, in which Messina retains a substantial shareholding besides managerial control, is the subject of a separate review in an ensuing article.

Year to Sept. 30	*Milled l.tons* (000)	*Grade* Copper* %	*Output in l.tons*	*Costs per l.ton* £	*Ore Reserves tons* (000)	*Ore Reserves* % *Cu.*
1957	915.0	1.55	14,723†	130.7	5,292.3	1.79
1956	842.2	1.7	13,100†	119.3	5,261.0	1.82
1955	816.1	1.68	14,202†	114.5	4,797.0	1.94
1954	806.8	1.73	13,688	108.5	4,520.4	1.99
1953	761.1	1.84	13,664	100.4	4,068.3	2.12

* Excluding jig tailings. † Including Umkondo.

But apart from the important Mangula interest, which has been brought to production during the past year so well ahead of schedule, Messina remains substantially identified with other new mining interests which have been the subject of development in the past few years. Among the smaller of these interests is the Umkondo mine in Southern Rhodesia. Umkondo was brought into operation in May, 1955, concentrates from this property being trucked to the Messina smelter for treatment. Last year Umkondo's costs were reduced by as much as 10s.1d. per ton. From its inception, Umkondo has never been more than a comparatively moderate-sized operation. The average monthly tonnage of ore broken and produced in 1956-57 was 4,050 tons assaying 4.49 per cent copper. Comparable figures for the previous year were 3,280 tons assaying 4.79 per cent copper.

Because of the substantial drop in the copper price during the past 18 months, together with the uncertainty of the future trend, it has been thought desirable to reclassify Umkondo's ore reserves into two categories—"proved and probable" and "possible." At September 30, 1957, ore reserves in the former category were estimated at 122,160 tons having a total average copper content of 4.47 per cent and "possible" ore reserves were estimated at 184,640 tons averaging 2.13 per cent. The overall reserve total was thus 306,800 tons averaging 3.06 per cent copper compared with 326,990 tons averaging 3.39 per cent. Given some recovery in the price of the metal it could be said that the volume of the ore reserves at Umkondo has been substantially maintained. But for the present, the payability of the "possible" ore may be in some doubt. In terms of volume, Messina's own ore reserves have been more than maintained, amounting to an estimated 5,292,000 tons at the end of September 30, 1956, compared with 5,261,000 tons but there has been a reduction in average grade to 1.79 per cent copper per ton against 1.82 per cent.

In addition to bringing the Umkondo and Mangula operations to production, Messina has also been paying attention to many other mining prospects in Southern Rhodesia. Some importance would appear to attach to the Alaska Copper mine which is situated about 13 miles west of Sinois, and control over this property was acquired by Messina last year. A reconnaissance by geological survey has been carried out over the 50 sq. miles comprising the original area of the Exclusive Prospecting Order.

Situated 65 miles to the west of the Alaska, the Sanyati mine provides a further possible mining operation of potential importance to the company. Further diamond drilling at Sanyati has increased the total calculated ore reserves, including sulphides and oxides, to 15,100,000 tons averaging 1.40 per cent copper, 1.35 per cent lead and 2.85 per cent zinc. From now on, exploration will be carried out by underground development and plans are already in hand for the sinking of a three-compartment shaft for prospecting the three main orebodies so far encountered.

The Beardmore Scheelite mine in Southern Rhodesia has been temporarily put on a caretaking basis, the heavy drop in the price of tungsten necessitating a cessation in operations before the production stage could be reached.

It may be recalled that it was in August, 1955, that Messina began negotiations with the government of Southern Rhodesia which resulted in the de-nationalization of the existing iron and steel industry and its re-formation under private enterprise. The new company, Rhodesian Iron & Steel Co. (Pvt.) Ltd. took over all the assets of the old undertaking and also Messina's iron ore deposits at Bukwe, which previously had been proved by them; the industry was thereby assured of ample reserves of good quality ore for greatly increased production for many years to come. The participants in the equity capital of R.I.S.C.O. are Messina (850,000); Lancashire Steel (500,000); Stewarts & Lloyds (500,000); Anglo American Corporation (250,000); British South Africa Co. (250,000); Tanganyika Concessions (250,000) and Southern Rhodesian Government (500,000); total (3,100,000). This project, involving a development programme of £8,000,000 is now well under way but cannot be expected to reach fruition for some time. Its ultimate benefit to the Messina company will however, be considerable and such benefit may well start to accrue at a time when the other newer ventures are also coming into their own.

Thus does Messina continue to enlarge the scope of its activities, particularly in Southern Rhodesia.

Year to Sept. 30	*Total Group Revenue* £	*Taxation* £	*Net Profit* £	*Dividends* £	*To Reserve* £	*Carry Forward* £
1957	3,663,944	446,151	1,159,674§	726,000	844,072	33,608
1956	4,423,823	684,908	1,793,676	1,386,000	420,000	29,807
1955	3,776,174	578,572	1,534,781	1,254,000	200,000	42,131
1954	3,353,907	523,962	1,382,676*	1,202,500	400,000	44,078
1953	3,451,990	578,290	1,538,796	1,300,000	90,000†	11,414

* Excluding £150,000 provided for contingencies written back and £102,488 profit on realization of investments.

† Excluding £150,000 provision for contingencies.

§ Including £422,558 capital profit on sale of mining property transfered to capital reserve.

M.T.D. (Mangula) Ltd.

DURING the past year, the public investor has been given the opportunity of participating in a new copper mining venture in Southern Rhodesia which has been developed by the Messina (Transvaal) Development. It was in early 1955 that the latter company gave its intention of opening up the Molly, Norah and Silverside properties belonging to Rhodesia Copper Ventures in which Messina held an 84 per cent interest. In 1956, R.C.V. changed its name to M.T.D. (Mangula), Messina at the same time retaining its interest and assuming management and working control of the properties.

It was originally calculated that Mangula's Molly section would be brought to production during 1959. In fact, development has been at a much faster rate than had been originally expected and production began some 18 month's ahead of schedule. Production of concentrates actually started in the last week of the financial year to September 30, 1957, and since that time output has been stepped up to 1,700 tons of ore milled per day. Concentrates produced have been averaging 50 per cent copper and this figure might well be improved upon in due course. A second Aerofall unit and additional equipment for the flotation plant are on order and are expected to come into commission by the first quarter of 1959, when output will be roughly doubled and operating costs substantially reduced.

Instead of the conventional layout the concentrator plant embodies the unique feature of a 22 ft. diameter Aerofall mill to take run-of-mine ore and turn this into flotation plant feed. Apart from normal teething troubles, the plant has given satisfaction and it is expected to achieve the targets aimed at with respect to capacity, recovery and grade of concentrate.

Meanwhile, there has been a substantial increase in ore reserves disclosed in the Molly-Miriam sections, these being estimated at September 30, 1957 at nearly 25,900,000 tons averaging 1.36 per cent copper compared with 17,900,000 tons averaging 1.6 a year earlier. The tonnage of copper metal contained in the latest reserves is estimated at 348,830 tons against 286,720 tons at the end of the previous financial year.

This comparatively low-grade operation has come into production at a time when all copper producers have been feeling the pinch. Indeed, until the appearance of the annual report early this year the question had been asked whether Mangula's production could, in fact, go forward without hindrance in view of the low metal price. On this point, there has been some reassurance, for it has been officially stated that even at the present reduced price for the metal Mangula's revenue from the sale of concentrates is sufficient to meet expenses. This is a deal more than might have been expected. It means that with any tangible recovery in the metal price Mangula, despite its low grade, will quickly be making good profits from the Molly section on which development work has hitherto been largely concentrated.

The authorized capital of M.T.D. (Mangula) is £5,000,000 in 5s. stock units of which £4,500,000 is in issue. In December, 1957, an offer for sale was made of 5,000,000 of the 5s. units at par to share and option holders of Messina. At that time the price of copper was no more than £182 per ton (for a time it drifted lower) and it was hardly to be expected that the offer would meet with an enthusiastic response. Indeed, of the 5,000,000 units offered, only 591,000 were subscribed for. At the current price of 6s. per unit members may regret having held off. Since Messina was already holding 84 per cent of the issued equity and the offer was not underwritten, Messina's interest in Mangula must thus remain in the region of 80 per cent.

Except for the fact that this may mean a considerable tying-up of Messina's funds beyond what might have been originally envisaged, it may in the long run prove no bad thing for the parent company that it has been required by general conditions and circumstances to retain such a big stake in the Mangula subsidiary. Mangula has largely completed its capital expenditure programme and should be in a position to obtain immediate benefit in terms of earnings from such recovery in the copper price as may eventually emerge.

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Rhodesian Corporation Ltd.

RHODESIAN Corporation was formed nearly thirty-five years ago in Southern Rhodesia and since its inception has been intimately concerned with the many branches of this territory's economic development. The company's scope is very wide, taking in land and townships, farming and ranching, tobacco growing, gold mining, industrial works and general investment. All these activities have characterized Rhodesian Corporation's association with Southern Rhodesia during the past three decades or more. It is fitting that the Company should again have done so well during the past year.

In recent years there has been a change of emphasis in the importance of the contributions made by the company's varying activities. There was a re-organization of capital in 1951 and since that time the policy has been followed of building up a substantial and broadly-based investment portfolio. In turn, this has meant a steady increase in investment income over the years and this source constitutes the largest single credit item in revenue accounts.

Seen against the whole of its activities, the company's operational mining interests, as distinct from those held indirectly through investments, are of only limited importance. They comprise, in effect, the Fred and Redwing mine.

Of considerably more importance to Rhodesian Corporation in terms of mining is the substantial shareholding in Falcon Mines whose main activity is the operation of the Dalny mine in Southern Rhodesia. In recent years considerable capital expenditure has been involved in the opening-up of Dalny but this should now tail-off. A separate review of Falcon appears below.

Rhodesian Corporation's farming operations last year enjoyed some recovery, this being mainly due to a higher tobacco yield coupled with a recovery in the average price received for leaf from 41d. per lb. to 48d. The current year's crop has not been helped by the weather and since a smaller acreage has been planted a lower yield seems likely, although this should be compensated by intensive production of a better grade leaf. However, average prices have been lower at the Salisbury auctions in recent months.

Among the more important of the company's industrial interests is the investment held in Rhodesian Brick and Potteries which paid a maiden dividend of 7½ per cent in respect of 1954-55 and was able to step up the distribution to 10 per cent for 1956. In the year to September 30, 1957, profits were more than maintained at £143,196 and the dividend repeated at 10 per cent. The brick company should continue to do well, as building activity in the Federation expands.

Land interests remain of considerable importance, total land and estate holdings in Southern Rhodesia now amounting to 43,820 acres. Of these, the Willsgrove Estate has now been approved for development as a township and preliminary work in this direction has been put in hand.

The dividend was repeated at 10 per per cent. £34,000 has been written off investments, compared with £5,000 in 1955-56. There was a credit balance carried forward of £68,321, compared with £37,244 at the end of 1956.

Meanwhile, there has been a further expansion in total assets which at the last balance sheet amounted to £1,385,947. Of this total, £265,328 represented the book value of farms, buildings freehold and other fixed assets, £642,938 investments, the greater proportion of which in quoted securities having a market value of £675,455, and current assets worth £334,415, including £183,142 cash and loans, against which there were to be measured current liabilities of £136,756. These figures follow the improving trend which has been seen in recent years.

Rhodesian Corporation is well placed to take full advantage of any further expansion in Southern Rhodesia.

Year to Sept. 30	Dividends Received, etc.	Farms and Estate	Share Dealing	Mining Revenue	Sundry Revenue	Property Revenue
	£	£	£	£	£	£
1957	67,809	21,896	36,733	8,013	5,446	72,347
1956	65,472	16,245	19,904	14,787	6,022	2,725
1955	59,915	30,264	18,638	13,899	6,743	1,253
1954	37,867	24,833	20,944	11,595	4,689	14,381

Year to Sept. 30	Total Revenue	Taxation	Net Profit	Dividends	To Reserve	Carry Forward
	£	£	£	£	£	£
1957	212,244	31,527	132,252	62,150	Nil	68,321
1956	125,155	4,170	71,106	62,150	Nil	37,244
1955	130,712	4,060	79,929	60,668	10,000	36,176
1954	114,309	4,089	70,752	53,778	15,000	31,076

Falcon Mines Limited

OF the three mines at present operated by Falcon Mines Ltd., the Dalny mine is far and away the most important. The company owns also the Bay Horse and Sunace mines, but during the year ended September 30, 1957, development work at Bay Horse yielded only 155 ft. of payable reef, while at Sunace operations are now confined to reclamation. In addition there is a small income received by way of royalties, amounting to about £400 a month, from the company's 600 copper claims at M'tuga in Northern Rhodesia which is let out on tribute. Recently, Falcon Mines has become interested in certain chrome claims in the Belingwe native reserve area of Southern Rhodesia.

The company has installed increased mill capacity at the Dalny mine of 20,000 tons a month, together with metallurgical modifications and additions designed to improve the gold extraction.

Delays occurred in delivery of the new plant units, and the extensions to the mill were not completed until near the end of the company's financial year. "Since the units were commissioned at the beginning of October, 1957, both mechanical and metallurgical difficulties have been experienced but these teething troubles are being overcome." This comment from the chairman, Mr. F. L. Wigley, at the annual meeting held in Salisbury, Southern Rhodesia, on March 31, 1958, has been amply justified. For the first five months of the current financial year Dalny milled 85,300 tons yielding an average grade of 6.2 dwt. gold per ton. This represents a material increase in both the grade and tonnage of ore being put through the mill and a continuation of this progress towards plant capacity should give results which will more than offset the loss of revenue received from the Bay Horse and Sunace mines.

During the financial year ended September 30, 1957, Falcon Mines earned profits of £103,685 against £115,927 the year before. The sum of £20,000 was appropriated to meet capital expenditure requirements at Dalny, £4,000 was written off unquoted investments, and the maintained dividend of 17½ per cent on the issued ordinary capital of £453,903 in 5s. shares absorbed £79,433.

At first sight development results last year of 50 per cent payability averaging 5.7 dwt. gold over 69 in. were disappointing. But this is only partly true as a considerable proportion of the footage accomplished was driven in areas outside the known zones of enrichment.

GOOD BOREHOLE RESULT

An interesting item of information announced along with the quarterly report for the three months ended September 30, 1957, was a borehole result in the Arlandzer Section at Dalny, which gave values ranging up 13.3 dwt. gold over a width of 44 in. The hole was drilled for protection and for information and although there are no plans at present to explore this area it may be a useful result to remember when this section of the mine is developed.

Dalny Mine Milling and Development

Year to Sept. 30	Tons Milled	Per ton milled			Devt. Footage	Ore Reserve*
		Yield	Grade	Cost		
	(000)	(oz.)	(dwt.)	s. d.	(000)	(000)
1957	190.8	33,208	3.48	33 10	17.7	457.0
1956	185.4	32,821	3.54	32 7	10.5	522.0
1955	162.6	27,568	3.39	30 0	5.8	457.0

*1957 value: 4.3 dwt. over 96 in.; 1956 4.7 dwt. over 100 in.; 1955 4.3 over 103 in.

Falcon Mines Ltd. Financial Results

Year to Sept. 30	Total Revenue	Taxation	Net Profit	Dividend	To Reserve	Carry Forward
	£	£	£	£	£	£
1957	119,458	Nil	103,685	79,433	Nil	15,941
1956	129,151	Nil	115,927	79,433	Nil	15,964
1955	155,783†	Nil	142,761	79,433	Nil	23,518

†Included net revenue of £35,854 from ore-treating stockpiled concentrates.

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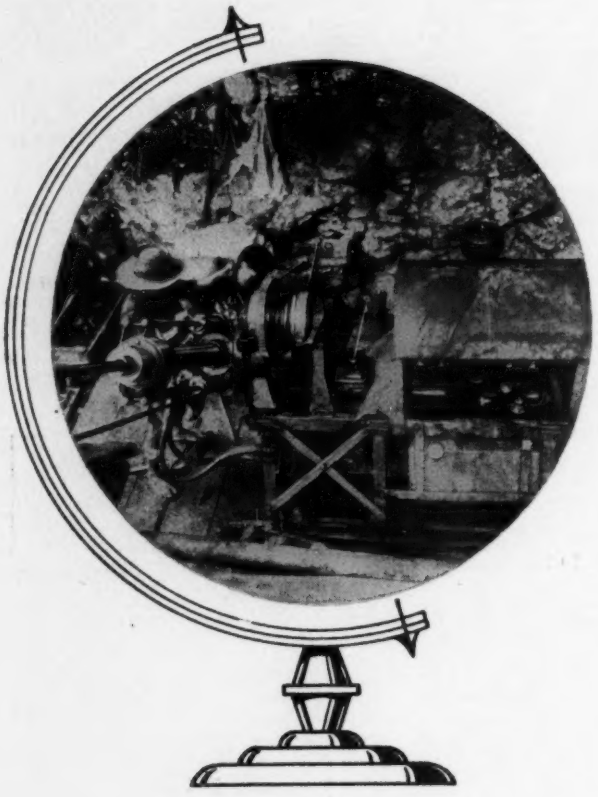

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London & Rhodesian Mining and Land Co. Ltd.

GREAT diversification is one of the prime attributes of the assets held by London and Rhodesian Mining and Land. It was probably this quality which led to a bid being made for the 5s. stock units during the summer of 1957, a bid which received neither the blessing of the Board nor the necessary support from the stockholders. This large area of activities is reflected in the company's lengthy name, which for market convenience is abbreviated to Lonrho.

The company's mining interests are widespread, and though it is largely concerned in the extraction of Rhodesian gold, it also holds stakes in South African companies including Henderson's Transvaal Estates, which company, as our review on page 279 describes, has holdings in coal and cement producers in the Union. Lonrho is an important participant in the real estate business in Rhodesia; it has a large and expanding ranching business; and both directly through subsidiaries, provides management, secretarial, technical and air-charter services.

SIX SOURCES OF REVENUE

Of the six revenue heads in the table below, fees and sundry revenue continue to be the largest single item, but the others are growing in size; mining is now producing much more than a few years ago; ranching, which five years back was bringing in £25,000 to £30,000 has advanced to an average of £50,000 in the last two years, and dividends have been steadily expanding.

Year to June 30	1955 £	1956 £	1957 £
Fees and Sundry Revenues	96,629	100,559	99,204
Dividend and Interest	52,448	58,244	69,086
Mining	43,318	53,226	49,926
Sharedealing	30,752	18,349	−21,684
Ranching	36,239	62,696	43,988
Property Revenue*	22,749	8,421	40,197

* Comprising 1957—revenue £2,712 and sales £37,485; 1956—£2,855 and £5,566; 1955—£7,994 and £14,755 respectively.

During the year ended June 30, 1957, Lonrho paid a dividend of 10 per cent, the third year for which a distribution of this size had been made. During recent years, payments to shareholders have risen from 5 per cent in 1950 to 6 per cent for the following three years, then to 7½ per cent in 1954, and since 1955 to the current figure of 10 per cent. Poor conditions in the stock market during 1956-57 led to a loss being incurred on the realization of shares—the first loss in this uncertain sphere for some years. This set-back outweighed the improvements made in other sectors, and consolidated earnings failed to cover the cost of the dividend.

Year to June 30	1955 £	1956 £	1957 £
Total Revenue	282,135	301,495	280,717
Taxation	69,861	85,616	75,562
Net Profit	60,578	60,066	48,720
Dividend	55,663	57,500	57,500
To Reserve	3,511*	506*	13,000*
Carry Forward	50,375	54,659	53,469

* After crediting £9,542 tax overprovision written back for 1955, £2,224 for 1956 and £20,590 for 1957.

The strength of the balance sheet made a drawing on past profits quite permissible; indeed, it was more than made up by the company being able to write back £20,590 tax over-provided in previous years. The bulk of this over-provision was in effect, carried to the general reserve, raised to £125,000. The £38,011 profit from the sale of Lonrho House, Bulawayo, was credited to the property reserve, brought up to £360,043.

CONSOLIDATED BALANCE SHEET

The consolidated balance sheet shows net current assets of over £300,000, equal to just above 1s. 6d. per 5s. stock unit, and total assets, taken at the book valuation less liabilities, except those to stockholders, were equal to more than 8s. per stock unit. This is a very conservative way of making this assessment. In mid-1957, when advising stockholders to reject the bid previously mentioned, the directors stated that their close knowledge of the assets in question supported by calculations made on a conservative basis by the accounting staff, confirms them in the view that the value of the net assets, without allowing for future appreciation, is in excess of 15s. per stock unit. This valuation takes a more up-to-date view of the value of the farms and ranches than the cost basis adopted for the balance sheet; town stands, too, are valued at cost in the balance sheet, and livestock have been valued by the directors for the accounts at approximately £5 per head of cattle, although during 1956-57, the average price received per head for slaughter was more than £27.

The Board has also disclosed that it was of the opinion that ranching was likely to realize profits of over £200,000 by 1966, and that an expansion from the present level of £44,000 would transform total profits.

The propert y side of the concern gives a revenue which naturally fluctuates with activity in that market. In 1956-57, income rose to more than £40,000 because of the sale of 32,975 acres, known as the Umsweswe River block, realizing a profit of £34,623. Even after this sale, Lonrho still owns 870,000 acres of land, and several town stands. A stand in one of the smaller places, Fort Victoria, was sold for £2,900, and this helped to swell the 1956-57 profits.

O.T.C. STATUS ?

The complex provisions of the Finance Act, 1957, regarding the establishment of overseas trade corporations, eligible for tax relief, may possibly apply to Lonrho, but its investment business would almost certainly have to be hived off before the company's activities in Rhodesia could rank for relief. An announcement will no doubt be made in due course on this matter; it cannot be an easy one on which to make a decision.

A nickel prospect has been found on one of the company's properties. at Gatooma, and arrangements have been made with International Nickel Co. of Canada for a further examination by geophysical means.

CAM AND MOTOR

With an output of 97,877 f.oz. of gold in the year to June 30, 1957, Cam and Motor remains Southern Rhodesia's biggest gold producer; in addition, the Pickstone mine, operating for the first time for a complete year, produced a further 14,705 oz.

The capital expenditure programme, initiated in 1954 and still in progress, has had beneficial effects, for the output of the Cam mine alone is the highest since 1937-38. At the end of last June, just over £200,000 of the original £950,000 programme remains to be spent, mostly on shaft sinking and underground installations. Part of the larger production, some 4,923 oz., came from re-treating accumulated slimes, an operation which commenced during the latest financial year and is expected to expand during the current year. Although the grade of these slimes is low, costs of treatment take less than one-third of the revenue. The profit from this source enabled the engineers to reduce the grade of ore taken from the mine and sent to the mill, thereby extending its potential life. Ore reserves at Cam at the end of 1956-57 amounted to 1,334,000 tons, a decline over the year of 82,100 tons, but the grade improved from 6.4 dwt. to 7.3 dwt. The changes stemmed, in part, from a re-calculation on an up-to-date basis. Additionally, the slimes which can be re-treated are estimated to be about 3,750,000 tons.

The reduction plant at Pickstone treated nearly 7,000 tons per month, as compared with an original estimate of 6,000 tons. The ore reserves increased by 10,104 tons to 295,440 tons, though part of this expansion was offset by a reduction in grade from 5.6 dwt. to 5.5 dwt. per ton.

As a result of the 1956-57 operations, a profit (after tax) of £374,466 was earned, and for the sixth successive year a dividend of 40 per cent was declared. Since the end of the year, an interim dividend of 20 per cent for the current year has been declared maintaining the rate of recent years.

CORONATION SYNDICATE

Two main gold mines come under the control of Coronation Syndicate: the Muriel mine, owned directly; and the Arcturus Mines, held through a wholly-owned subsidiary. During the year to June 30, 1957, a third mine, the Tebekwe, owned through a subsidiary, ceased operations, and the plant and material is being made ready for disposal. Before closing, Tebekwe produced 6,512 f. oz., for a working profit of £17,662; Arcturus during 1956-57 yielded 17,750 oz. of gold and a working profit of £64,611, and the Muriel mine 16,680 oz. and £134,455.

Group gross profits for 1956-57 amounted to £159,949 against £151,158; taxation took £39,254 against £44,559, and the dividends totalled 22½ per cent, £90,562.

MAZOE CONSOLIDATED MINES

Lonrho owns 94 per cent of the issued capital of Mazo Consolidated Mines, operating in the Mazoe district of Southern Rhodesia. During the year to June 30, 1957, it yielded 10,324 f.oz. of gold for a working profit of £46,184.

The British South Africa Co.

OVER a period of almost 70 years, the British South Africa Co. has proved that a company formed under a Royal Charter can be just as flexible to meet changing conditions as the more familiar joint stock companies.

This article has been based on information given at the Annual Meeting of the company, when the new Budget provisions regarding Profits Tax were not known.

The 1957 Finance Act established a new type of taxation entity, an overseas trade corporation, not liable to U.K. tax on profits earned on trading operations carried on abroad, except in so far as they are distributed to shareholders. This innovation offered "Chartered" the possibility of escaping some of the onerous burden of taxation in the U.K., a burden which has hampered this company in common with other similar types. It has been necessary to divide "Chartered's" interests into two separate parts. One is the overseas part, concerned with the receipt of mineral revenues from Northern Rhodesia and with the estates in Africa. The other is the investment section, growing in importance with every year, which has been sub-divided into two, one for permanent investment, the other for investment dealing.

UNTIL 1986

This taxation relief, which is considered in greater detail later, is a change which should be of advantage to "Chartered." Not all earlier changes could be so reckoned. In 1933, for example, "Chartered's" sphere of activities was reduced by the Government of Southern Rhodesia purchasing the mineral rights in that territory. In 1947, the ownership of the whole railway system in Southern Rhodesia, Northern Rhodesia and the Bechuanaland Protectorate was sold to the respective governments, and, in 1950, it was agreed that the mineral rights in Northern Rhodesia would be transferred to the territorial Government in 1986 without the payment of compensation. After the loss of its mineral revenue "Chartered" will, no doubt, continue to be interested in the development of mining and other projects in the Federation. In the meantime, the Board is building up an investment portfolio which will form the basis of a finance and investment company. The 1950 agreement provided that the Government would impose no special tax on mineral royalties, but instead would have until 1986 20 per cent of the net mineral revenues received by "Chartered," this amount is to be regarded for the purpose of Northern Rhodesian income tax as a charge on the profits of the business.

Over the years since 1950 "Chartered" and its subsidiaries have built up a tremendous investment portfolio; at the end of September, 1950, which completed the year in which the royalty concession was first limited, "Chartered's" consolidated balance sheet showed quoted investments at a book value of £12,800,000 and a market value of £14,596,307, while the unquoted investments stood at just over £1,000,000, yielding a total income for the year of £747,597. At September 30, 1957, the portfolio had a book value of some £25,700,000, and the quoted investments had a market value of about £11,300,000 more than the book value, so that the investments were worth at least £37,000,000. Investment income in 1956-57 amounted to over £2,800,000. A comparison of these figures indicates the energy with which the directors have entered into the task of founding a solid basis for the company from 1986 onwards. During the last few years there have, of course, been extremely favourable opportunities for the making of large profits, and since these were abnormally high, the directors were well placed for retaining a large proportion of earnings, while giving to shareholders some of the immediate benefits by making increased distributions.

ROYALTY BASIS

Although the importance of investments has grown in the last few years, over two-thirds of "Chartered's" income is derived from royalties, rents and fees. Because of its importance the Board has announced the basis on which the royalty on copper is calculated:

> As soon as possible after the end of each calendar month there is ascertained the average for the month of the quotations for Standard (Electrolytic) Copper for Cash (mean) and the average for the month of the quotations for Standard (Electrolytic) Copper three months (mean) as quoted by the London Metal Exchange. The Arithmetical mean of the averages so ascertained less 10 per cent of such Arithmetical mean is used as the basis for the valuation for royalty purposes of copper produced during that month. The amount of the royalty payable in respect thereof is 5 per cent of the value so ascertained plus 10 per cent of so much of that value as may exceed £80 per ton of copper.

It has been suggested that this formula can be simplified for practical purposes as follows: The royalty payment would equal 13¼ per cent of the average of the cash and three months' price each month less the sum of £8. The formula operates while the price of copper is over £80 per ton.

During 1956-57, the average copper price for the purposes of royalty calculations, that is to say, after deduction of 10 per cent from the mean of the averages of the monthly cash and three months was £220, against £316 in the previous year, and as a consequence mining royalties, fees and rents, after allowing for the Northern Rhodesian Government's share, declined from £12,250,000 to £8,750,000. With the average price for royalty purposes in the first five months of the current year only £161, and with production having been cut back, it is clear that royalty income during the present year is likely to contract. In fact, in order to reach the 1956-57 average, copper would have to reach an average royalty price of £262 for the remaining seven months of the year, or very little below £300 for the metal in the market, and this makes no provision for any cut-back in output. Sir Ellis Robins, in his presidential address to shareholders, said that copper at £400 or even £300 per ton was unhealthily high, a suggestion which carries no hope at all of "Chartered's" royalty income being in the same region as the reduced level of 1956-57.

The royalty income decline of 1956-57 was countered to a limited extent, by an increase in investment income, which was on the whole rather surprising since copper dividends were being cut. The increase from £3,127,761 to £3,412,795 was largely due to increased dividends from investments in gold mining companies and interest on gilt-edged securities and on loans to Bancroft and the Kariba hydro-electric scheme. It remains to be seen whether this side of the business can offer a similar degree of resilience during the current year, in view of the further sharp cuts which have been made, not unexpectedly, in copper dividends.

O.T.C.

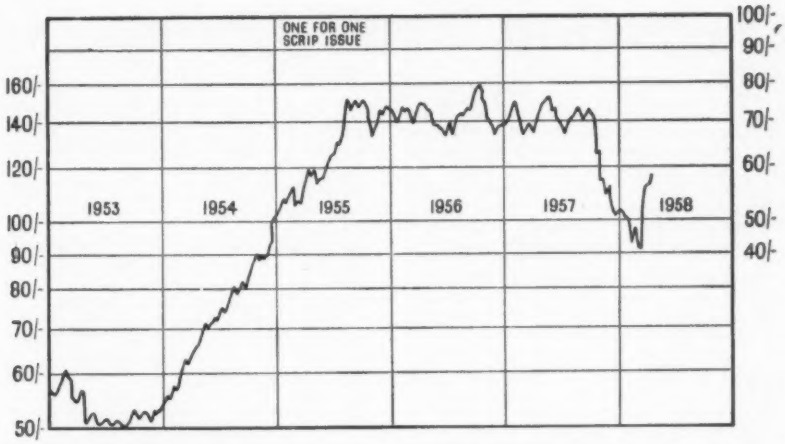
The possibility of a further reduction in "Chartered's" dividend rate cannot be overlooked, though there is the prospect of relief coming from the overseas trade corporation provisions. The incorporation of The British South Africa Co. Investments Ltd. to operate in the U.K. as an investment dealing company, and of Cecil Holdings Ltd. for the purpose of acquiring certain fixed investments held by the new investment dealing company will lead to royalty revenue, and certain smaller income items from Africa, becoming exempt from U.K. income tax and profits tax, except insofar as they are distributed by way of dividends. On the assumption that net mineral revenue will amount to £5,400,000 in a full year—a figure which makes some allowance for the worsened conditions in the copper market—and that a dividend of 4s. 6d. is maintained, and that tax rates in the U.K. and overseas are unchanged, the tax saving of the new provisions to "Chartered" will be of the order of £1,000,000 a year. This is apart from any adjustment which might be made in the tax provisions in the 1956-57 accounts.

Now that "Chartered" is operating through three separate channels instead of

THE BRITISH SOUTH AFRICA CO. AND ITS SUBSIDIARY COMPANIES
EXTRACT FROM CONSOLIDATED PROFIT AND LOSS ACCOUNT

Year to Sept. 30	*Mining Royalties* Rent and Fees*	*Income from Investments*	*Taxation U.K. after D.T.R.*	*Taxation Overseas*
	£	£	£	£
1957	8,758,252	2,878,947	2,138,411	3,949,234
1956	12,262,909	2,674,524	2,331,340	5,245,447
1955	10,154,158	2,175,599	1,940,869	4,331,263
1954	7,397,216	1,567,947	2,287,433	2,904,441
1953	7,787,440	1,390,731	3,125,349	2,905,128
1952	7,066,386	1,450,453	3,044,849	2,641,336

*Mining royalties, rents and fees after providing for the payment to the Northern Rhodesian Government of 20% of the net revenue derived by the company from the exercise of its mineral rights in Northern Rhodesia.



Weekly London Stock Exchange prices of the 15s. stock units of the British South Africa Co-

as a single entity, some means must be devised to channel the tax savings into the development of the Rhodesian Federation. It would be possible, for instance, for the parent company to make investments in its subsidiaries. The details are of less consequence, however, now that the general principle has been established.

DEPRECIATION

The other great unknown which affects earnings capacity is the need to provide for depreciation in the market value of investments. By the end of last September quite substantial sums had been written off some investments, but further adjustments since that date are probably required. At September 30, 1957, the market value of quoted investments showed an appreciation over book value of £11,342,000. A similar exercise carried out on March 21, 1958, showed an appreciation of only £7,532,000. In many cases, it will not be necessary to make provision for the change, since the market value will still be above the book value, and hence no actual loss has been suffered. The appreciation of the quoted investments is only part of the additional reserves of strength owned by "Chartered," Sir Ellis Robins estimated that the unquoted securities which stood last September in the books at almost £8,900,000 had an undisclosed appreciation of £4,300,000.

The resilience in investment income was completely absorbed by the need to provide heavily for depreciation in investments—£626,000 against £10,000. In the end, the consolidated profit before tax came to £10,937,892 against £14,625,678. The revenue authorities in the U.K. and in Rhodesia, who together take over one-half of "Chartered's" gross profit, naturally suffered from the cut-back. Their share in 1956-57 fell by roughly £1,500,000 to £6,087,645, and the net profit amounted to £4,830,496 as compared with £7,010,460. Slightly less than one-half of this sum, £2,266,780, was distributed to shareholders by way of dividends; the interim of 1s. 3d. per stock unit being followed by a final of 3s. 3d. The remainder was retained in the business, mainly by an appropriation of £2,500,000 to the general reserve, though a small amount was retained by a subsidiary and another added to the carry forward.

Apart from the companies recently formed under the reorganization caused by the overseas trade corporation requirements, "Chartered" owns three subsidiary companies. These are The Rhodesia Railways Trust, Cecil Investments, and Charter Properties. By far the most important appears to be The Rhodesia Railways Trust. Formerly about 19 per cent of the capital of the Trust was held by the public, by in 1957 "Chartered" made an offer of 60s. per share for those publicly held. The response to this offer was sufficient to enable the company to acquire compulsorily the rest of the capital. At September 30, 1957, the Trust's quoted investments had a book value of £5,382,048 and a market valuation of £7,192,582; it owned additionally unquoted securities with a book value of £106,787. It was officially stated at the time of the 1957 offer that it was not intended to alter the investment trust nature of the Trust's business, but that it would be convenient to co-ordinate its investment policy with that of the parent company. The especial sphere of co-ordination in mind was the extent of its dollar investments and the relative emphasis to be placed on revenue earning as opposed to capital appreciation without the necessity of considering whether such policies commended themselves to the other holders of the equity of the Trust. Since that time rather more emphasis has been placed on investments held by the Trust in concerns domiciled in the U.S. and Canada. At the end of 1955-56, the Trust held just over one-quarter of its investments, measured by market value, in those two countries, but by September, 1957, the proportion had risen to 35 per cent. Only a very small proportion of the investment portfolio is in secured investments or in preferred stocks.

CAPITAL APPRECIATION

The capital appreciation aspect of the Trust's policy is indicated by relating the Trust's income from investments for the year ending September 30, 1957 of £417,738 to the total of the market value of its quoted investments at that date and the value of its unquoted investments. This suggests that the Trust was obtaining only 5.7 per cent gross on its securities. The return on North American securities admittedly tends to be less generous than can be generally obtained here, but the return appears to be on the low side, though this will almost certainly be rectified as the years pass and the dividends improve.

The operations of the Cecil Investments have, in the past, been financed mainly by loans from the parent company; at the end of September, 1957 these amounted to over £2,000,000: its mining and other investments at that date had a market value of £1,699,624.

As its name implies, Charter Properties is concerned chiefly with freehold property in the Federation of Rhodesia and Nyasaland. Again, this company has been supported financially by loans from the parent company.

"Chartered's" interests in companies which are not subsidiaries include flour milling, cement manufacture, an hotel, an undertaking for making ferro-chrome and an interest in a forestry undertaking. The flour milling interest dates back to 1924, when in partnership with Spillers, "Chartered" helped to found Rhodesian Milling and Manufacturing, which now operates eight mills in Southern and Northern Rhodesia, and is responsible for maintaining a regular supply of wheat to these territories.

In 1957, the Government of Southern Rhodesia decided to hand the steel industry at Que Que back to private enterprise. A consortium was formed to acquire the undertaking, "Chartered" agreeing to subscribe for 250,000 shares out of a total equity capital of 2,250,000 Ordinary shares and for £950,000 First Debenture stock, carrying an option at par over a further 190,000 shares.

"Chartered" is a principal shareholder in Bancroft Mines, which is reviewed in this issue under Rhodesian Anglo American, and it owns an interest in the Kansanshi mine, which is being examined to see whether this marginal value property is worth de-watering and re-opening.

Already the company has undertaken to provide £4,000,000 for the hydro-electric scheme at Kariba, designed to supply both Northern and Southern Rhodesia with the major portion of its power supply. The first turbo-generator is expected to come into operation in the early part of 1960.

EXPLORATION ACTIVITIES

Although the days of "Chartered" receiving a royalty are numbered, the end is still sufficiently far off for the company to have an intense interest in exploration in Northern Rhodesia. Part of its activities in this direction is in the charge of Chartered Exploration which has prospecting rights over about 100,000 sq. miles. The management of that company is in the hands of the Anglo American Corporation group; a third party in this agreement is Consolidated Goldfields. The Rhodesian Selection Trust Group has its own exploration companies, and Rio Tinto is also prospecting over an area of some 19,000 sq. miles in Northern Rhodesia, and over a further 2,500 sq. miles, the mineral rights of which are owned by Rhodesia-Katanga. "Chartered" holds 10 per cent of the capital of three of the R.S.T. prospecting and exploration companies, and owns a 15 per cent interest in the mineral rights held by Rhodesia-Katanga.

It is most likely that large parts of this huge area in which "Chartered" is concerned, directly or indirectly, will fail to produce minerals of any economic significance. It is equally likely that some parts will give satisfactory results. These will give "Chartered" an even wider base, besides contributing to its founders' policy of developing this part of Central Africa.

Rhodesian Selection Trust Group

IN the year 1956 Rhodesian Selection Trust at one time faced a price of £437 a ton on the London Metal Exchange; in the year 1957 the price of the metal was consistently—and for a long period drastically—below the level which its chairman has many times stated is necessary if the producer is to get a fair price and the consumer is to be sure of getting the metal he needs. Transformations of this speed and magnitude are rare even for the copper mining industry. But R.S.T. has faced this one with equanimity.

CLEAR CONFIDENCE

Obviously, the year 1957 was one of reduced profits. But all was not gloom; and perhaps four explanations lie behind the clear confidence that was noticeable in Sir Ronald Prain's speeches throughout the year. The first is that the price of copper had been so high (and so high for so long) that inroads were being made into normal copper usage. The fact cannot be avoided that for certain usages copper has lost out to aluminium; and as far as can be foreseen, permanently. Over about 8 per cent of present copper usage a battle against substitution is being fought. Whatever else it has done the downturn has stopped the rot.

Secondly, although the world's copper producers have been discomforted by this sudden reversal in their fortunes, it is clear that the Rhodesian producers are as well placed as any to stand the strain. This is not to say that, being high-grade producers, they are necessarily low-cost, but their costs do fall as the selling price falls.

Thirdly, the price of copper is absurdly low and no consumer but recognizes that it must rise quite considerably. Yet there is a chance that the price may rise in a more controlled manner and settle down at a level that will disconcert nobody. The supply is there to cope with any sudden increase in demand and, with reasonable luck and careful management, there is no reason why an upturn should touch off another mad scramble for metal.

Finally, a definite link exists between the growth of the copper industry and population growth. Thus in the nature of things revival is assured. But copper consumption also grows *per capita* as the living standards of the world rise. Whereas the world consumption of copper a head is only about 3 lb. it is about 18 lb. in the U.S. So that growth is doubly assured. In other words, the present difficulties of the copper mining industry cannot but be temporary even if an end cannot yet be forecast for them.

If these considerations help to explain the equanimity which has characterized Sir Ronald Prain's speeches in the past year they are not the whole story. For though they all point to the belief that R.S.T. can expect to work more profitably than at present, they ignore the fact that R.S.T., like all great institutions (and particularly those that work in the less developed areas of the world) exist for other purposes besides making a profit. These other responsibilities have been enumerated on several occasions by Sir Ronald in recent years and if they are examined show unmistakably that R.S.T. had a more rewarding year than might have been judged from a study of the L.M.E. quotations.

The first two are easily grasped—the responsibilities to the shareholders and to the workers of the enterprise. The third is also well known—responsibility to the government—but it obviously takes on great significance in a country like Rhodesia where the country is fast developing and the copper mining industry bulks large in that development. Close voluntary co-operation is needed.

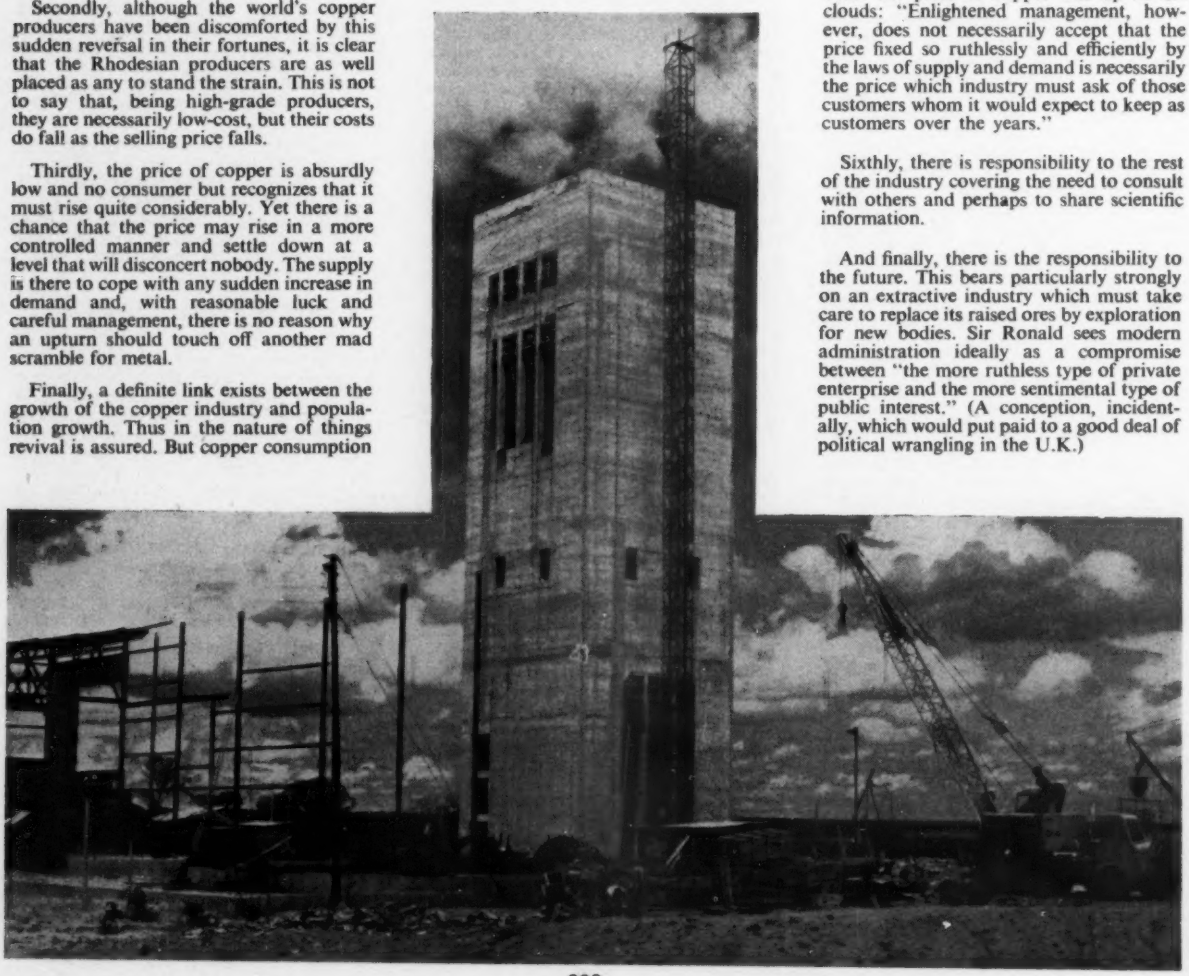
Fourthly, Sir Ronald places responsibility to the community and he specifically mentions as an example the duty to avoid creating an imbalance by the building up of a mining industry in an underdeveloped country. He quotes especially the support of R.S.T. for hydro-electric schemes such as Kariba and of railway development. Both of these, of course, are also of direct assistance to the copper mining industry. But a more obvious example of disinterested development arising from moral responsibility to a community is the Kafue Flats agricultural scheme.

RESPONSIBILITY TO THE CONSUMER

Fifthly comes responsibility to the consumer, and here we cannot do better than quote the views Sir Ronald expressed at a recent lecture at the Royal School of Mines —views which he so often expressed before when the price of copper was up in the clouds: "Enlightened management, however, does not necessarily accept that the price fixed so ruthlessly and efficiently by the laws of supply and demand is necessarily the price which industry must ask of those customers whom it would expect to keep as customers over the years."

Sixthly, there is responsibility to the rest of the industry covering the need to consult with others and perhaps to share scientific information.

And finally, there is the responsibility to the future. This bears particularly strongly on an extractive industry which must take care to replace its raised ores by exploration for new bodies. Sir Ronald sees modern administration ideally as a compromise between "the more ruthless type of private enterprise and the more sentimental type of public interest." (A conception, incidentally, which would put paid to a good deal of political wrangling in the U.K.)



So much for the theory. But the practice of the idea demands that the success of R.S.T. in any year must be judged on the extent to which it has lived up to its seven several responsibilities. One can run quickly through them. The responsibility to the future is being discharged through the large-scale and long-term prospecting work being carried out in Northern Rhodesia by R.S.T. Services Ltd., and the investigations into prospects in Southern Rhodesia and Nyasaland by R.S.T. Exploration Ltd. In discharge of responsibility to the industry the exchange of research findings continues and the Salisbury laboratory was opened in December. Consultations were had with other producers on ways of stabilizing prices that would be acceptable to consumers. This leads directly to responsibility to consumers; these, too, shared in talks on pricing policy in the past year. They had, too, the benefit of cheap and plentiful copper—the result of heavy expansion programmes over the last decade. Duties to the community have already been touched upon—Kafue, railways among them—but particularly, perhaps, one thinks of Kariba. Twice in its short history the cofferdam has been threatened by immense floods. But the realization that the copper companies are backing it to the full is sure guarantee that the scheme will go through whatever difficulties may have to be faced.

SHARE PURCHASE SCHEME

The responsibility to the shareholders will be touched on in the later examination of the accounts; but that to employees requires a special comment. In the course of the year R.S.T. introduced a share-purchase scheme which is available to all employees with an income of more than £200 a year. The shares can be bought by setting aside a fixed proportion of wages and the R.S.T. group adds to the extent of 50 per cent. There are various devices for making it more profitable to the employee to keep his money in the group's shares though he can sell out if he wishes. Something like 16 per cent of European personnel and 12¼ per cent of the eligible African personnel have joined the scheme. It represents a considerable advance toward a more stable labour force and community on the Copperbelt. Indeed, it falls under the heads of several "responsibilities" though primarily, of course, under that of duty to employees.

It should also create in the minds of employees a surer knowledge of the nature of industrial enterprise. This is undoubtedly necessary as the report of the commission which investigated the strikes of the summer of 1957 showed. By this report the European Union was shown to be less aware of its responsibilities than a union with its immense privileges should be. The report also called for reform of the procedures of conciliation and a tidying of the law relating to a closed shop. At the time of going to press the government's attitude to the report has not been disclosed but it may be assumed that it will move in the direction that R.S.T. is moving toward—the creation of a real partnership on the Copperbelt.

The faith in the future that is held by the R.S.T. Group is demonstrated (at left) by the concrete headframe of the No. 12 (Prain) Shaft here seen under construction at Mufulira West

RHODESIAN SELECTION TRUST
(Year Ended June, 1957).

	Roan Antelope		Mufulira		Chibuluma	
PRODUCTION	1955-6	1956-7	1955-6	1956-7	1955-6*	1956-7
Milled (000 s.tons)	5,555	5,853	4,007	4,481	126	504
Mill Feed (% cu)	2.09	1.95	3.11	2.86	5.75†	5.83†
Saleable Output (l.tons cu)	88,714	86,294	94,500	98,695	4,340	14,494
Revenue per ton	£336.6	£250.8	£340.6	£259.5	£319.6	£253.5
Cost per ton	£167.3	£156.2	£153.6	£145.5	£153.0	£124.8
FINANCE						
Total Revenue (£000)	29,512	21,953	32,223	25,746	749	4,066
Costs (£000)§	14,827	13,483	14,731	14,431	636	1,089
Taxation (£000)	5,650	2,945	6,583	4,142	—	—
Net Profit (£000)	8,359	4,217	9,290	6,092	2	1,396
Dividends (£000)	5,617	3,033	6,887	4,834	—	—
To General Reserve (£000)	3,000	1,150	2,500	1,350	—	1,395
Carry Forward (£000)	27	₰72	126	41	2	3
Dividends (net) per share	5s. 0d.	1s. 6d.	25s. 0d.	9s. 9d.	—	—
RESERVES						
S.tons (000)	89,287	95,168	133,102	151,1	7,300	6,652
Grade (%cu)	3.14	3.09	3.35	3.35	5.23‡	5.1‡

*Four months only.
†and 1955-6 0.25 per cent cobalt; 1956-7 0.36 per cent cobalt.
‡and 1955-6 0.35 per cent cobalt; 1956-7 0.24 per cent cobalt.
§Excluding Loan Interest:

	1955-6	1956-7
Roan	£64,000	£51,000
Mufulira	£46,000	£34,000
Chibuluma	£73,000	£220,000

Although the unconsolidated profit and loss account of Rhodesian Selection Trust shows that income is derived almost exclusively from the receipt of dividends from Mufulira Copper Mines—a mere £2,751 out of a total of over £3,000,000 came from other sources—this interest is only a part of the vast possessions and influence of the R.S.T. group. The consolidated accounts in contrast combine the figures for Rhodesian Selection Trust and 10 subsidiaries.

TEN SUBSIDIARIES

These subsidiaries can be classified as follows: the operating companies Mufulira Copper and Chibuluma Mines; a property, Chambishi, awaiting development when the necessary finance can be arranged; another property, Baluba, where the orebody is still being delimited. Then, there are three companies formed to render various types of service: one to provide administrative, technical, purchasing and other services; another to investigate prospects in Southern Rhodesia and Nyasaland; and the third to hold investments of a semi-permanent nature. The housing and real estate interests of the group outside the Copperbelt is held by Vainona Estates, a company which also operates the pilot scheme to assess the agricultural potentialities of the Kafue Flats. Finally, two companies, Choma Mines, and London Nyasaland Mining Corporation. The boundaries of the group include a famous and powerful producer, Roan Antelope Copper Mines, which is an associated company. It partners R.S.T. in the Rhodesian Selection Trust Exploration venture, and the Vainona project. Roan itself is interested in a number of other companies, though only Ndola Copper Refineries is considered legally as a subsidiary. The group's sphere of influence will probably be extended as the result of negotiations for a grant of a mineral prospecting concession over the tribal areas of the Bamangwato in Bechuanaland.

FINANCIAL SET-UP

In the year to June 30, 1957, R.S.T. and its subsidiaries made a net profit of £7,382,602, after providing £4,118,838 for taxation. Just over one-third of that net profit—£2,658,334—belonged to minority shareholders, leaving £4,724,268 attributable to Rhodesian Selection Trust. Rather more than one-half of that amount was distributed to shareholders by way of dividends, amounting to 2s. per share before Rhodesian tax, or 1s. 3d. after making that deduction. Almost the whole of the remainder of the year's profits was transferred to the general reserve, thereby restoring some of the transfers rendered necessary by the scrip issues made by R.S.T. and Mufulira. Each year the group earmarks large sums for replacements and obsolescences, and although by the end of June, 1957, these had grown to an aggregate of virtually £15,500,000, fixed assets had a book value of over £18,000,000. As R.S.T. has been in existence for 30 years, it seems obvious that these assets would cost a good deal more than this sum if they had to be provided at present day prices, and that book values give only a conservative view of their worth.

The group profits after tax amount to £7,250,000. Current assets are only a shade under £27,000,000 and trade investments and loans have a book value of £4,500,000. Current liabilities stand at £17,250,000, and provisions for replacements at £2,500,000.

MUFULIRA COPPER

At present Mufulira is one of the Rhodesian "Big Four" producing copper at a normal rate of over 100,000 tons, though this will not be reached under the voluntary scheme to reduce temporarily the output of copper in order to achieve a better balance between supply and demand. The large increase in copper output achieved since the end of the war has been the consequence of changing over from conventional stoping methods to block caving. The next stage for Mufulira is to develop the additional ore known to exist to the west of the existing mine, an area designated as Mufulira West. This will, it is estimated, raise Mufulira's output by 50 per cent, making Mufulira the second largest underground copper mine in the world.

The cost of this development is £16,000,000 and finance is to be raised in three separate ways: European housing will take £2,000,000, and will be provided by a property company which will own the houses. Secondly, since the end of the financial year Mufulira has made an issue of £7,000,000 6¾ per cent debenture stock 1967-82. The stock, issued privately at a price of 98 per cent, will not be fully paid up until the summer of 1960; one-quarter of the issue price was paid on issue and one-quarter will be paid on July 1, of each of the years 1958 to 1960 inclusive. Thirdly,

Mufulira expects to find the balance of £7,000,000 from its own resources. The whole operation is based on the expectation that Kariba will be supplying electric power in time for the completion of Mufulira West by late 1961.

The Mufulira furnaces smelt both the ore from the company's own mine and a share of the concentrates from Chibuluma. In 1956-57, Mufulira produced 9,428 l.tons of blister copper for Chibuluma. Its own production of saleable copper in the same year totalled 98,695 l.tons, of which more than one-half—in fact, 57,452 tons in the form of wirebars. Roughly one-quarter, 23,661 tons was in copper cathodes and the remaining 17,582 tons was in blister cakes.

PROSPECTING COMPANIES

During 1956-57, power was imported from the Le Marinel hydro-electric station in the Congo and an improvement in coal supplies from Wankie led to the suspension of coal imports from Lobito Bay, and the costly practice of wood-burning. The use of fuel oil has also been stopped.

Mufulira holds 45 per cent of three companies engaged in prospecting for minerals over a substantial area in Northern Rhodesia; the remaining capital is held as to 45 per cent of the total by Roan Antelope and 10 per cent by British South Africa Co., from which company the exclusive prospecting licences were obtained. The three companies are Kadola Mines, working to the south-west of Ndola; Luapula Mines, operating along the east bank of the Luapula River, Northern Rhodesia, and Mwinilunga Mines, which had exclusive prospecting rights over the Kansanshi Farm area, later transferred to Kansanshi Copper Mining Co. Ltd., and is still actually searching along the Rhodesian side of the border with the Belgian Congo. Some 30 per cent of the capital of Chisangwa Mines is held by Mufulira Copper, the remaining proportion behind held by Rhokana Corporation (30 per cent); Roan Antelope (30 per cent); and British South Africa Co. (10 per cent). It is prospecting the Western Concession area in Northern Rhodesia.

COPPER-COBALT FROM CHIBULUMA

About 34 miles south-west of the Mufulira property is Chibuluma, whose copper concentrating plant commenced operations in March, 1956; the concentrates are sent to other Northern Rhodesian copper companies for smelting, since it is at present too small to erect its own smelter. The company's cobalt plant at Ndola started working in April, 1957 and the resulting copper-cobalt matte is being sent to Belgium for refining. The question of building a refinery to enable Chibuluma to produce its own cobalt metal is under consideration. The company was financed by a capital of £1,000,000, which has since been augmented by retained profits of £1,400,000, and by a £5,000,000 loan from the General Services Administration of the U.S. The loan is repayable in cobalt and copper, and interest is also payable in the same way. It is hoped to reduce the amount of the loan outstanding to £4,000,000 during the current year. Over the longer term, the grade of ore is expected to fall; the copper content in 1956-57 was 5.84 per cent, and cobalt 0.36 per cent. The reserves, estimated to be 6,652,311 tons at the end of June, 1957, have an average value of 5.10 per cent copper and 0.24 per cent cobalt.

WAITING FAVOURABLE OPPORTUNITY

But for the depressed state of the copper market and the unpropitious conditions in the financial markets of the world, it is likely that further steps would have to be taken to develop the large deposits of ore at Chambishi, north-west of Ndola. They have been estimated at 35,000,000 tons with an average copper grade of 3.37 per cent. In order to produce 25,000 tons of copper per annum, a capital expenditure of £13,000,000 is estimated to be needed. Such a sum cannot be raised on suitable terms at present, and the whole matter awaits improvements in the markets named.

DELIMITING OREBODY

Like Chibuluma, Baluba is primarily a copper deposit; it is also the largest undeveloped cobalt property in the world. There is no present intention to develop this property and several reasons can be advanced for this decision. First, it is considered necessary to know more about the limits of the orebody and of its characteristics; second, the metal and financial markets are in no fit state for the raising of finance, and third, it is thought possible that the property could eventually be developed in conjunction with the neighbouring Muliashi property belonging to Roan Antelope.

SERVICE COMPANIES

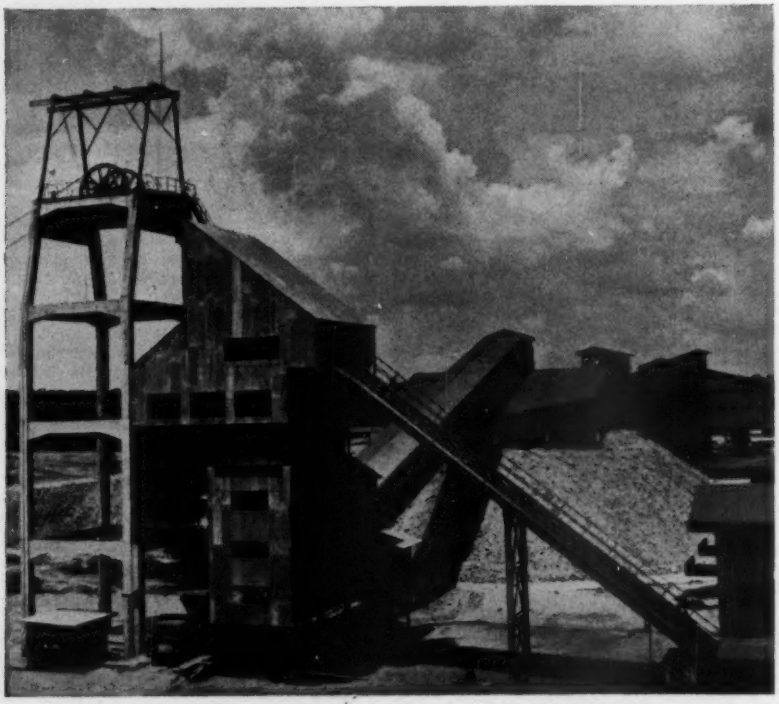
Formed in 1951, Rhodesian Selection Trust Services provides administrative, managerial and technical services. The concentration of the provision of this type of service has enabled the various companies to enjoy a service which would have been quite uneconomic otherwise. Recently it employed a helicopter under charter arrangements in field operations.

Of rather more recent origin is the establishment of Rhodesian Selection Trust Exploration Co. Primarily it is concerned with the investigation of prospects in Southern Rhodesia and Nyasaland, and although some projects examined have inevitably proved to be abortive, other investigations have given better promise, and will be the subject of further exploration. The £313,500 issued capital is held as to 15½ per cent by Rhodesian Selection Trust, 42½ per cent by Roan Antelope and 42½ per cent by Mufulira Copper.

More recently still, it was decided to hive off investments which were considered to be of a semi-permanent nature. For this purpose, a wholly owned subsidiary, Rhodesian Selection Trust Investments has been formed with a capital of £100,000 of which one-quarter has been subscribed. This comparatively small capital need not, however, indicate the importance of this company's holdings since it would be possible to operate on loans from the parent company. The motives behind this move are given as "administrative and other reasons." Presumably these include some consideration for tax matters.

AGRICULTURAL EXPERIMENT

One of Rhodesian Selection Trust's subsidiaries is far removed from the exploitation of the metals lying under the Central Federation, though in a sense one



The Norrie Shaft concrete sheave tower at Chibuluma Mines Ltd. The ore waste bins are shown, with the plant area in the rear

of its aims is to utilize the mineral wealth of the country. This concern, Vainona Estates, has a dual function. It covers the housing and real estate interest of the group outside the Copperbelt, but it is also engaged on an extremely interesting and potentially significant agricultural scheme. It is running a pilot polder at Kafue Flats aimed at ascertaining whether some of the engineering problems of a greatly extended scheme can be solved or not. The scheme, which naturally has the support of the authorities, is also examining the possibilities of a crop rotation of wheat, rice and barley. If this suggestion proves feasible it would make a major contribution to the food supplies of the Federation. The early results from the farm near Mazabuka are reported to be encouraging.

ROAN ANTELOPE

The Roan Antelope mine is one of the best known mines in the world by the man in the street; probably on account of its romantic name, given because of the spectacular manner of the first discovery of copper on its site over 50 years ago. Since the war ended in 1945, the mine output has been more than doubled, and although this has been accompanied by a steady drop in grade over the period, the output has risen by just over 50 per cent. With its mine output in 1956-57 exceeding 5,750,000 tons of ore, the mine is the largest underground copper mine in the British Commonwealth.

This tremendous output is backed by huge reserves of approaching 100,000,000 tons, having an average grade of 3.09 per cent copper, the greatest proportion being in sulphide copper. Part of these reserves, which are gross tons, subject to mining losses, are in the Muliashi Special Grant area, mentioned under the heading of Baluba, since the two properties might be developed together in the future.

The Roan mine is capable of producing blister copper only but this will be overcome when the electrolytic refinery at Ndola begins operations later this year.

Roan took part of the load in smelting some of Chibuluma's concentrates, producing 5,646 s.tons, for that company; it also produced 1,627 s.tons for Nchanga Consolidated Copper.

Out of its 1956-57 revenue, Roan Antelope provided £1,250,000 for replacements and obsolescence. Of the net profit of £4,250,000, a little over £3,000,000 was paid out in dividends, and the major portion of the remainder was transferred to the general reserve, thereby restoring part of the deductions made in February, 1957, when a scrip issue of four-for-five was made. The consolidated balance sheet of Roan Antelope and its subsidiary company shows a healthy net current assets position. Current assets, mostly in quick resources, amount to over £21,000,000, whereas current liabilities, including £2,500,000 of replacement provisions, only just top £14,000,000.

CAPITAL COMMITMENTS

The group has capital commitments of £1,167,000 not shown in the balance sheet, and this is only one of claims which can be made against the company's resources. It is liable for capital payments in respect of participation in the various prospecting companies, and it is committed to lend to the Federal Government £4,000,000 and the Northern Territory £1,500,000. The 1955-56 accounts contained an allocation of £1,100,000 to meet these obligations undertaken towards the authorities, and a further £500,000 was set aside out of the 1956-57 accounts for the same purpose. As this second allocation was below the average needed to find the whole of the money by 1960, Sir Ronald Prain explained that the Board does not consider it essential to reserve the whole of the contribution during the period. Such automatic reserve might involve too great a strain on annual profits, and the Board's policy will be to reserve each year such sums as may appear to be reasonable in relation to the profits earned. If the amounts reserved by 1960 do not measure up to the commitments, the Board proposes to find the balance from the resources discussed earlier. If that is found necessary, appropriations from profits after 1960 will be continued in order to replace the amount taken out of cash resources.

NDOLA COPPER REFINERY

Excellent progress has been made with the construction of the electrolytic copper refinery at Ndola and the first section of the plant, designed to refine 55,000 tons annually, is expected to come into operation later this year. The plant will ultimately be extended to a capacity of 110,000 tons a year.

One of the interesting features of this company is the manner in which finance was raised. This has been accomplished almost completely by an equity issue, the other items on the liability side of the balance sheet are comparatively so small as to require no detailed comment. This equity has been subscribed in the following proportions: one-third by British Insulated Callender's Cables and two-thirds by Roan Antelope.

REDUCED PROFITS

The low price of copper is reflected in the profit-earning capacity of the three operating companies in the group during the first half of the current year. Some relief has been obtained, however, from a reduction in operating and administrative expenditure.

This cut is derived mainly from smaller royalty payments and from a decrease in the copper bonus payable to employees, though there are probably other economies which have been effected. In spite of these reductions, Mufulira Copper made an estimated working profit of £2,160,000 in the first six months of 1957-58 against £5,479,000 in the comparable period of 1956-57. The production of copper in the later period was slightly higher at 45,059 tons than the 43,737 tons of the first half of 1956-57. This is because the earlier period was affected by labour troubles and a sizeable reduction will be seen if the sales of the December quarter of 23,159 tons are compared with the 28,376 of the June 1957, quarter.

Much the same story is told of Roan Antelope. Copper sales at 38,793 tons in the first half of the current year were virtually unchanged, but the estimated profit had dropped to £1,155,000 against £3,967,000. Chibuluma is somewhat different. Its production for the June quarter, 1957, was reduced because of a lack of smelting capacity at the other mines, and this has been made good during the early part of 1957-58. Profits in this instance have contracted from £872,000 in the first half of 1955-56 to £585,000 in the latest half year.

During the Royal Visit to Roan Antelope Copper Mines Ltd. on July 9, 1957, Her Majesty the Queen Mother greeted miner P. J. Smith who, with a crew, demonstrated the charging up of a face with explosives preparatory to blasting

Rhodesian Anglo American Ltd.

THE year 1957 for Rhoanglo, as for other copper producers, was marked by the drastic fall in the price of metal. Nevertheless, the tone of the annual reports that came out in the summer of 1957 was indisputably confident. The main ground of confidence was that the pace of world development was only temporarily halted and that it would inevitably, and, perhaps, shortly, renew its unward trend. This ground for assurance remains now as solid as when it was put forward in spite of the deepening recession in the United States and elsewhere; a temporary halt to industrial expansion cannot affect the general trend of copper consumption that has emerged during the twentieth century.

Wisely the decline in the copper industry's fortunes was taken as an opportunity to point out in the Group's annual reports some elementary lessons that had been lost sight of in the heady prosperity of the past few years. The first was the need to operate the mines in a fully economic fashion. The properties of the group are sound and are well capable of standing up to the failure of demand for the metal to grow. But they do require economic management. In the recent past this has been lost sight of. Both the African and European Unions have in their turn presumed too far on the prosperity of the Copperbelt in their anxiety to press home sectional advantage. Now the warning has been given. The mines are still capable of giving to both groups incomes far beyond what they could earn elsewhere in the Federation, but only if they co-operate in the maintenance of industrial efficiency and discipline.

The needs of the Federation were also well in mind in the annual reports. With a heavy development programme in front of it and the prospect of reduced foreign exchange earnings and internal taxation through the fall in the copper price, the Federation will have to exercise considerable caution. It will need on the one hand, to push through half-completed development work to the point at which an economic return will become available; it will need on the other hand, to refrain from non-productive work on the ground that this is likely to prove inflationary. The chairman congratulates the Federation on having put aside large sums for development work in the palmy years. This should certainly see Kariba through.

The chairman of Rhoanglo has long recommended economic orthodoxy to the Federal Authorities even when the price of copper gave hints of almost untold prosperity; the wisdom of orthodoxy to both the Federation and to the Group is now clear in these less comfortable times.

With an investment portfolio valued in the market on June 30, 1957, at over £62,000,000 and a further £3,500,000 recorded as the book value in unquoted companies, the size and importance of Rhodesian Anglo American is clear. As to the direction of investments it can be stated that these are overwhelmingly in copper producing companies, although Rhoanglo's collective stake in companies producing other base metals and coal is not inconsiderable.

Rhoanglo's most important investment is in Rhokana Corporation not only by reason of its majority shareholding but also because Rhokana has large shareholdings in other mining companies in which Rhoanglo has a smaller interest. The force of this statement becomes obvious by perusing the following table summarizing both companies' holdings in the more important copper producers operating in Northern Rhodesia.

Company	*Rhokana's % of Equity*	*Rhoanglo's % of Equity*	*Rhoanglo's* holdings: total % of Equity*
Rhokana	—	52.4	52.4
Nchanga	33.6	21.3	38.9
Bancroft	43.4	1.8	24.5
Mufulira	26.6	3.6	17.5
Chibuluma	26.7	—	14.0
Kansanshi	—	23.4	23.4

* Direct and indirect.

Other lesser, but collectively important, investments in the company's portfolio include the subsidiary, Rhodesia Copper Refineries, and two service companies, Rhoanglo Mine Services and Rhoanglo Trustees. Rhoanglo also holds about 10 per cent of the issued capital of Rhodesia Broken Hill Development and a substantial interest in Wankie Colliery. Tanganyika Concessions. (See page 296), is also in the portfolio and there are, too, a number of exploration companies, a merchant bank in Rhodesia and, finally, the Rhodesian Iron and Steel Company.

With the bulk of its investments in copper, Rhoanglo's fortunes vary directly with the average price ruling for the metal. The price of copper and, for that matter, of lead and zinc have been declining since March 1956 and therefore, the market values of its investments have also been decreasing. Similarly, dividend income has been affected and revenue from this source in the year ended June 30, 1957, fell to just under £5,000,000 from approximately £7,250,000 in the preceding year. The current year's accounts reflecting as they will still lower average prices for copper, lead and zinc will undoubtedly result in a smaller yearly distribution. This is partially confirmed by the net interim dividend for 1957/58 year of 1s. per stock unit which compares with the corresponding payment of 1s. 6d. in the previous year.

At the end of June 1957, Rhodesian Anglo American's issued capital was £6,500,000 in 10s. 0d. ordinary stock units and, apart from its current liabilities, its other liabilities were solely due to stockholders in the form of either capital or revenue reserves. In February 1958, however, more permanent financing for Bancroft was proposed which resulted in Rhoanglo offering £4,000,000 6 per cent loan stock at £95 per cent to its own stockholders. Subscribers to the issue were given a free option to take up Rhoanglo ordinary stock at 80s. 0d. each in the proportion of one option for every £4 of loan stock subscribed. The option expires on March 31, 1963.

RHOKANA CORPORATION

The Rhokana Corporation is interested in the production of three commodities—copper, cobalt and uranium. Copper, both quantitatively and qualitatively, is the most important, but, in recent years, the output of cobalt has risen steadily. Uranium is of little significance and the late Sir Ernest Oppenheimer told shareholders in November 1957, that it would never yield anything more than a small profit.

The investment portfolio is almost exclusively concerned with copper and contains Bancroft Mines, Nchanga Consolidated, Rhodesia Copper Refineries, and Mufulira Copper. In addition, it holds over one-quarter of the issued capital of Chibuluma Mines, which is producing blister copper and a copper-cobalt matte, of the Chambishi and Baluba Mines, as yet undeveloped, and a 30 per cent interest in Chisangwa Mines, an exploration company prospecting a large area to the west and north-west of the Copperbelt.

In the year to June 30, 1957, Rhokana's production of copper consisted of 65,571 tons of electrolytic and 22,735 tons of blister; its cobalt output was 1,330 tons. These tonnages were derived from 4,265,000 tons of ore milled, roughly one-half of which came from the Mindola section, and approximately one-quarter each from Nkana and the South orebody.

The ore reserves at Mindola are about 60 per cent of the total, those at Nkana North about 20 per cent, and the same at the Nkana South. This means that rather too much ore at present is being taken out of the Nkana reserves in comparison with Mindola. This will be rectified when a further shaft is sunk on the Mindola section. Primarily, this shaft is intended to improve ventilation, but it has been made larger than would be necessary for that purpose alone, and it will be equipped to hoist ore. When the new shaft is in commission, mining operations will be much more flexible, and an increased production of copper could result. Fully developed ore reserves at the end of last June are somewhat less than two years' supply to the mill. By itself this is not a very large developed reserve but as it is backed by partly developed reserves equal to a further 3½ years' supply, the situation is satisfactory. The total estimated reserves are sufficient to give the mine a life of over 30 years, a period which will satisfy all but the most captious.

The 1956-57 production mentioned above plus income from investments yielded a net profit of £9,872,000 and by adding a tax provision not required and the carry forward, over £10,500,000 was available. Capital expenditure, mainly on the Mindola shaft and partly on improving metallurgical techniques, absorbed £3,500,000. The general reserve was strengthened by the allocation of £650,000 and the dividend, amounting to 45s. 0d. net, took slightly over £5,500,000.

Transfers to reserve, such as those mentioned, have given the balance sheet even greater stability. Current assets exceeded current liabilities by £3,250,000, and £3,600,000 of loans and Government securities have not been included as current assets. Furthermore, trade investments and shares in other companies stand in the balance-sheet at £10,500,000. As investment income from this source produced a net £4,000,000, the book value of the investment seems to have been made on a conservative basis.

NCHANGA CONSOLIDATED

Both Rhokana and Nchanga operate mines on their own account, Nchanga being much the larger producer. Nevertheless Rhokana, with its substantial income from dividends, has much the same net income as Nchanga. But this rough parity will change in favour of Nchanga when the company's expansion plans come into operation.

At present ore is extracted underground from the Nchanga West orebody where the copper is of relatively high grade. The company has, however, huge reserves of lower grade ore in the Nchanga orebody; together they amount to 154,750,000 tons, averaging 4.55 per cent copper. In order to obtain a more balanced production, the Nchanga orebody is to be worked. In the early stages opencast methods will be used and this will keep costs low for a number of years. Subsequently, underground mining will commence from the pit when it has gone to a depth at which the changeover to lode mining will be economic.

The company has a third orebody at Chingola. The reserves there are on a much smaller scale—7,250,000 tons—but they have the high average value of 5.68 per cent copper. In addition, there are 2,250,000 tons of reserves in the Nchanga River lode, averaging 4.21 p.c. copper.

The scheme will take about two years to bring to fruition, and when it is in operation Nchanga's life should be much longer. This is because although the throughput will rise from the present 3,250,000 tons to a scheduled 4,250,000 tons, the reserves of the open-pit can be included in calculations estimating the mine's life. The new programme will give a much more flexible production policy, and this should be of immense advantage in times when the price of the metal fluctuates. The general intention is to take about two-thirds of the increased ore production from Nchanga West, that is to say, rather less than now, about one-fifth from the open pit, and the remainder from Chingola.

These schemes have involved Nchanga in great capital outlays. It has been calculated that in the past three years the additional cost of fixed assets has risen by £6,500,000, and in the same period about £9,750,000 of profits have been retained, the bulk being in 1955-56, when profits were abnormally large as a consequence of the high copper price.

BANCROFT MINES

So far Bancroft has had more than its fair share of ill luck. But when the present phase of reorganization is over, it should be a very profitable concern if the price of copper were to recover to around £200 per ton. At the present time, however, Bancroft has temporarily suspended operations owing mainly to two factors.

The first is that difficult mining conditions in the No. 1 shaft area, which contains high-grade ore, have delayed building up the mine tonnage to the envisaged level of 150,000 s.tons per month. This compelled too much reliance on the poorer grade ore from the No. 2 shaft area which raised the cost of producing copper metal—a heavy burden in the early months of 1958 when copper fell to £160 per ton. The second reason for suspending operations was that it was decided to cut the group's production by 10 per cent and that it would be better to eliminate the Bancroft potential, transferring any surplus between that potential and a cut of 10 per cent in group output to the other mines. In this way, the group was able to keep its cheaper producers in full swing.

To compensate Bancroft shareholders for this proposed sacrifice, Rhokana and Nchanga offered Bancroft a sum sufficient to cover interest on loans, the continuation of primary development and pumping at No. 1 shaft. This deal provided Rhokana and Nchanga with higher profits than if they operated a 10 per cent cut in production, while Bancroft receives financial help and a respite from the cares of production.

The financial structure of Bancroft was erected on the assumption that the company would be operating economically by mid-1957, and the repayment of loans was timed to start during 1958. This programme could not be kept, and new agreements have been made. These provide for short-term loans amounting in all to £7,500,000 to be available until April 1959; for authorization to issue £7,500,000 participating Preference shares in exchange; and, for the granting of options over 3,000,000 shares of 5s. 0d. at 20s. 0d. each, up to March 1963. Thus by the middle of next year, Bancroft will have in issue 22,000,000 ordinary shares, a further 3,000,000 under option and 7,500,000 Preference shares. There will also be a £5,000,000 loan convertible into Notes in December 1960.

In spite of the present mining difficulties, the mine would appear to have a great future. Its ore reserves at June 30, 1957, amounted to 102,500,000 million s.tons, with an average grade of 3.88 per cent copper. These reserves alone would have provided the mill with almost 30 years' supply, even after its capacity had been raised from 150,000 tons per month to 300,000. It has been unfortunate that high prices of copper ruled during a vital stage of development, thereby increasing costs under the influence of the copper bonus without compensating advantages from the sale of any copper. It has been unlucky in encountering water at an early stage in its career. But Rhokana and Nchanga still have faith in the proposition; over the years that faith will almost certainly be rewarded.

KANSANSHI COPPER

The history of the Kansashi mine extends over fifty years, but it was closed down for a long period during that time. The growing demand for commodities, however, which has been a feature of the post-war period, led to new prospecting for copper and to a re-examination of the Kansanshi mine. Agreement was reached in 1951-52, and a separate company, Kansanshi Copper Mining Company Limited, was formed in 1953 with an option over the property. This option was exercised in December 1954.

Although the mine is often considered to be in the Northern Rhodesian copperbelt, it is about 100 miles west of the Nchanga mine and the deposits are of a quite different nature. The copper at Kansanshi is contained in veins and in certain beds of the wall rocks which are mineralized to variable distances and over irregular widths.

At one time it was hoped that it would be possible to earn sufficient from treating ore from underground development and from limited stoping to finance expenditure on an exploratory programme, designed to delimit the extent and value of the deposits. This plan was not completely successful, partly because of water troubles underground, partly because of difficulties in dealing with the oxide ore nearer the surface, and partly because of the copper price.

The company raised £500,000 and it seemed that this would enable the various mining and metallurgical problems to be solved. Unfortunately, a few months later the water difficulty increased and disaster overtook the mine. Heavy pumping equipment was sent to the mine, but it was eventually decided not to reopen the mine while copper prices were around the then current price of £180 a ton.

When conditions are sufficiently propitious for the mine to be re-opened, production will be on a larger scale than the 400 tons per month being treated before the flooding. There are indications that the higher-grade oxide ore can be treated economically by leaching with sulphuric acid. An investigation is being made during this period of suspended

COPPER COMPANIES OF THE RHODESIAN ANGLO AMERICAN GROUP

		PRODUCTION			ORE RESERVES		FINANCE							
							PROFIT AND LOSS (£000)				APPROPRIATIONS (£000)			
Company	Fin. Year	S.tons Milled (000)	Mill Feed (% Cu)	Saleable Output (l.tons Cu)	Total (000 s.tons)	Grade (% Cu)	Copper Sales	Investment Income	Costs	Net Profit	Taxation	Dividends	General Reserve and Cap. Exp.	Carry Forward
Rhoanglo* ..	1956	—	—	—	—	—	42,424†	3,049	377	22,885‡	15,511	5,850	1,500	348
	1957	—	—	—	—	—	23,458†	3,657	408	13,542‡	8,387	4,225	900	378
Rhokana ..	1956	4,140	2.60	81,566	122,853	3.14	31,700	5,138	16,582	22,056	6,120	8,778	7,200	549
	1957	4,265	2.54	88,306	133,616	3.13	24,164	4,027	16,627	12,772	2,900	5,652	4,148	845
Nchanga ..	1956	3,222	4.84	114,723	150,693	4.76	40,346	—	16,742	16,220	9,450	10,500	6,500	925
	1957	3,116	4.99	112,583	164,399	4.60	30,368	—	16,981	9,529	5,700	7,000	2,500	954
Bancroft ..	1957	236	2.37	3,398	102,573	3.88	204	—	1,684	L1,256	—	—	—	Dr.1,256

*Consolidated Accounts. †Operating Profit. ‡Net profit attributable to Rhodesian Anglo American Ltd. Indicates loss.

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operation to determine whether the necessary sulphuric acid for leaching can be made on the spot from the sulphide ore, or whether sulphuric acid will be brought from the Copperbelt. After leaching the ore, metallic copper would be produced by electrolytic deposition. This would require large quantities of electric power, which would necessitate connecting the mine with the Copperbelt grid. Against this capital expenditure can be weighed the advantages of producing metal instead of sending a concentrate to Nkana, and of eliminating costly fuel oil.

Kansanshi also has perpetual mining rights in 20 areas of 300 acres each, and perpetual mining rights, excluding diamonds and precious stones, over an area of about 2,500 square miles.

RHODESIA BROKEN HILL DEVELOPMENT

Named after the famous Australian lead-zinc producing area, Rhodesia Broken Hill Development is the main source of lead and zinc in the Anglo American group in Rhodesia. Its interests range rather further than those two metals since it owns a vanadium property of 300 claims, a couple of manganese properties and a coal area of 900 acres. Since the end of the war, the output of zinc has grown, fairly steadily, rising from 17,190 tons in 1946 to 29,500 in 1957. The production of lead has fluctuated considerably over the period, output in 1957 being around 15,000 tons. In spite of the extraction of ore in the intervening years, the ore reserves have grown from 2,618,000 at end-1948—the first figures available—to 3,357,000 tons at end-1956.

The sharp fall in the prices of lead and zinc during 1957, has cut deeply into the high trading profits of the previous year, and although the tax authorities suffered a more than proportionate reduction in their share, net profits came out to £909,219 against £1,342,745. The heavy capital expenditure programme, designed to improve the supply of power to the mine and the township has been allocated £450,000, though it would be possible to contend that roughly £100,000 of that amount came from tax provisions no longer required and profit from the sale of the Iron Duke mine. The year's dividends, amounting in all to 11d. (4d. interim and 7d. final), absorbed almost £600,000 as compared with 1s. 3d. in each of the three preceding years.

WANKIE COLLIERY

The announcement on March 28th, 1958, that Wankie Colliery had decided to place on a caretaking basis one of its three collieries—the No. 1 colliery and the smallest—has exploded the widely-held belief that only the stringency of railway transportation in Rhodesia would prevent the company from expanding its throughput to the plant capacity of 5,600,000 tons per annum. As Wankie is the sole producer of coal in Rhodesia, this supposition seemed eminently reasonable. However, cutbacks in production on the Copperbelt and the fact that power is being imported from the Belgian Congo, have rendered redundant the extra production capacity. There is, too, the question of price and it is hoped that by this measure the price of coal will become stabilized in the Federation.

The present position is that the full current demand will be supplied from Nos. 2 and 3 collieries with an output of 4,250,000 tons a year which it is thought will not be exceeded for a number of years. The capacity of the No. 1 colliery is 1,200,000 tons a year.

The lowered annual output will have the effect of lengthening Wankie's life which is about 100 years on the basis of 5,000,000 tons a year. Moreover there is also a large high-grade open-pit from which the output potential is approximately 100,000,000 tons.

But Wankie's interests extend far beyond the 42,000 acres over which coal mining rights are held some 210 miles north-west of Bulawayo. It has a 50 per cent interest in the issued capital of Lubimbi Coal Areas, carrying out investigations into the possibility of establishing an oil-from-coal plant at Lubimbi. It also owns a 75 per cent share interest in North Zambesi Coal Syndicate, owning coal mining rights over 50 square miles in Northern Rhodesia.

PROSPECTING COMPANIES

Rhoanglo's exploration spearheads are Anglo American Rhodesian Mineral Exploration, which is conducting a prospecting and geological investigation in both Southern Rhodesia and Nyasaland, and Chartered Exploration. Rhoanglo's interest in this latter company is 20 per cent of the issued capital; its field of operation is confined to large areas of Northern Rhodesia over which it holds exclusive prospecting rights.

Rhoanglo has a comparatively small direct interest in Rhodesian Iron and Steel Company. Previously, the iron and steel works at Redcliff, Southern Rhodesia, belonged to a Commission under the Government, but the assets were transferred to private enterprise in 1957.

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Tanganyika Concessions Ltd.

ONCE again Tanganyika Concessions Ltd. has been able to report a record result. During the year ended July 31, 1957, the Consolidated Profit and Loss Account showed a Profit after taxation of £4,309,796, an increase of £327,184 over the previous year. It must be emphasized, however, that these figures result from the operations of the Union Minière du Haut-Katanga and the Benguela Railway Co. for the year ended December 31, 1956, and reflect the much higher copper prices then ruling.

Tanganyika Concessions Ltd. was incorporated in 1899 by Sir Robert Williams for the exploration and development of projects in Africa. It was as a result of the company's activities that the mineral deposits in the Belgian Congo were discovered and the Union Minière du Haut-Katanga was formed in 1906 to acquire and to work them.

The vital part which the Union Minière plays in the economy of the Company is illustrated by the large amount of revenue derived from that source and by the fact that at July 31, 1957, its holding of 179,760 Union Minière du Haut-Katanga Parts Sociales, of a book value of £4,338,513, had a value based on the market quotation in Brussels, of £64,842,000. In addition Tanganyika Concessions Ltd. holds 61,384 4½ per cent Obligations of Belgian Francs 100 each and is entitled to participate in Mining Royalties payable by Union Minière du Haut-Katanga. During the year ended July 31, 1957, the Company's share of the Royalty amounted to £773,693, after deduction of Belgian taxation.

Tanganyika Concessions Ltd. continues to hold 90 per cent of the issued Share Capital and the whole of the Debentures of the Benguela Railway Co. Receipts by the Company from the Railway have continued to increase and during the year to July 31, 1957 it received a dividend of Escudos 16.50 per share, and £611,780 4 per cent Income Debentures were redeemed. These Debentures were written down in the books of Tanganyika Concessions Ltd. during less prosperous times, with the result that of the redemption of £611,780 referred to above, the sum of £509,780 was credited to Capital Reserve.

At the Annual General Meeting of Tanganyika Concessions Ltd. held in Salisbury on January 23, 1958, Stockholders approved the arrangements which had been made for a bonus issue of registered Ordinary Stock to be made on the basis of one new Ordinary Stock Unit of 10s. for each Ordinary Stock Unit held on January 31, 1958. The issue was provided from the existing unissued capital and was effected by the capitalization of reserves as follows:—

Capital Reserve	£2,148,650
Profit Unappropriated	£1,682,762
Issue of Ordinary Stock	£3,831,412

The Chairman of Tanganyika Concessions Ltd., Captain The Right Honourable Charles Waterhouse, M.C., D.L., in addressing the meeting, referred to the recent substantial falls in the price of copper and its consequent effect upon the fortunes of Union Minière du Haut-Katanga and on the copper freight rates charged by the Benguela Railway Co. Captain Waterhouse was able to say, however, that in the case of the Benguela Railway Co. other classes of mineral traffic, and especially iron ore from the Province of Angola, have done much to fill the gap caused by the reduction in the freight rates of copper.

Year to July 31	*Total Income*	*Total Expenses*	*Taxation*	*Net Profit*	*Dividend on Ordinary Stock*	*Carry Forward*
	£	£	£	£	%	£
1957	4,700,684	245,888	145,000	4,309,796	9s. 6d. per Unit	2,677,917
1956	4,340,931	230,819	127,500	3,982,612	9s. 0d. per Unit	2,290,533
1955	3,253,207	152,377	100,000	3,000,830	70%	1,903,290

Set out over-leaf is a table showing the Company's results during the last three financial years.

UNION MINIERE DU HAUT-KATANGA

During 1956 prospecting continued at the usual rate and preliminary work at the Kamoto deposit was concluded. The tonnage of ore proved has largely confirmed earlier estimates.

Mining operations resulted in the extraction of 7,228,263 tons of ore, of which 6,665,161 tons were sent to the treatment plants. Barren overburden removed increased by 2,150,000 cu. metres to 12,850,000 cu. metres during the year and reflects the more intense exploitation of open-cast mines and their increasing depth. The open-cast mines of Musonoi and Ruwe provided 70 per cent of the total copper content of all ore mined.

Copper output in 1956 rose to 247,452 tonnes, again a record, as compared with 234,673 tonnes in 1955. Cobalt production amounted to 9,089 tonnes, compared with 8,567 tonnes during 1955, an increase which made possible a price reduction from $2.60 to $2.35 per lb. A further reduction to $2.0 per lb. was made early in 1957.

In order to develop the use of cobalt, Union Minière du Haut-Katanga has participated in a research programme on the utilization of the metal and has also set up its own Cobalt Information Centre which will put into effect the research programme referred to above.

The production of zinc concentrates increased from 114,167 tonnes in 1955 to 203,772 tonnes in 1956.

The third unit of the Marinel Hydro-Electric Power Station was brought into service during March, 1957, and the fourth and last unit was completed in mid-1957. Power produced by the various stations totalled 1,293,274,300 kWh. as compared with 1,013,651,400 kWh. during 1955.

The 10-year period, during which power will be exported to Northern Rhodesia, started on October 1, 1956.

BENGUELA RAILWAY CO.

The accounts of the Company for the year ended December 31, 1956 again disclose an increase in Net Revenue from Working, this item having increased from Escudos 146,093,217 in 1955 to Escudos 221,811,958 in 1956. The preliminary traffic results for 1957 show a decrease of the order of 11 per cent when comparing the Net Operating Receipts with 1956.

Consequent upon the good results achieved during 1956 the Benguela Railway Co. declared a dividend of Escudos 16.50 per share, as compared with Escudos 11.0 per share for the previous year.

During December 1957 the Portuguese Government authorized the doubling of the Issued Capital of the Benguela Railway Co. from Escudos 330,000,000 to Escudos 660,000,000 by capitalization of the following items:—

Profit on partial revaluation of the assets of the Company	Esc. 220,000,000
Transfer from General Reserve	110,000,000
Increase of Capital ...	Esc. 330,000,000

TANGANYIKA HOLDINGS LTD.

Tanganyika Holdings Ltd. was formed in 1950 in order to take over the Northern Rhodesian and East African interests of Tanganyika Concessions Ltd. and The Zambesia Exploring Co. Ltd. and to act as Registrars in London for Tanganyika Concessions Ltd., supplying office services for the other companies of the group. The principal investments of Tanganyika Holdings Ltd. consist of interests in Rhodesia-Katanga Co. Ltd. and Kansanshi Copper Mining Co. Ltd., Kentan Gold Areas Ltd., and a programme of mineral exploration in Northern Rhodesia which is being carried out by the Rio Tinto group.

RHODESIA — KATANGA CO. LTD.

Rhodesia-Katanga Co. Ltd. retains 35.24 per cent of the equity of Kansanshi Copper Mining Co. Ltd., in which Tanganyika Holdings Ltd. has a direct interest of 6.61 per cent. Anglo American Corporation of South Africa Ltd., who with their associates own 41.37 per cent of the equity, act as Consulting Engineers. In addition, certain shareholders have advanced £500,000 by way of loans bearing interest at 5½ per cent per annum and carrying the right to subscribe up to July 1, 1960 for Ordinary Shares at par. Rhodesia-Katanga's share of this advance amounted to £196,652, and, in order to finance this commitment, £250,000 Unsecured 6 per cent Loan Stock 1965, carrying an option of conversion into £1 Ordinary Shares at £2 per share up to July 1, 1965, at which date any unconverted Stock will be repaid at par, was issued to shareholders on May 17, 1957. The issue was wholly underwritten by Tanganyika Holdings Ltd., who received as consideration an option to sub-

scribe for 50,000 £1 Ordinary Shares of the Company at £2 per share exercisable up to July 1, 1965.

On October 31, 1957, the Kansanshi Mine was flooded to a point some 250 ft. below the collar of the Main Shaft, bringing production of ore and all other operations to a stop. Fortunately all personnel were able to withdraw safely from the Mine. Pumping indicated that dewatering would not present a major engineering problem, but the Board decided to put the Mine on a care and maintenance basis pending a full report and recommendations as to future action from the Consulting Engineers.

On December 16, 1957, the Company announced that at present copper prices nothing would be gained by re-opening the Mine for the extraction of sulphide ore only, since the proved and inferred reserves of sulphide vein ore were still not considered sufficient to justify sustained output beyond a production rate of 400 l.tons of copper per month. To be profitable, production would have to be on a larger scale, and it would therefore be necessary to use the oxide ore reserves. Investigations into economic treatment of the oxide reserves, while not yet successful in finding any method of concentration by flotation or gravity methods, had shown that at least the higher grade ore could be leached with sulphuric acid, and an estimate would be made of the relationship betwen the quantities of sulphide ore available and the amount of sulphuric acid required to leach the known oxide ore reserves. Investigations are continuing, and a full report by the Consulting Engineer is expected at an early date.

In the meantime, the shareholders have agreed to provide up to £100,000 to finance additional working capital.

The Rhodesia-Katanga Co. also owns perpetual coalmining rights in 20 areas of 300 acres each and perpetual mineral rights over an area of about 2,500 square miles, both subject to 15 per cent interest of the British South Africa Co., and an exploration programme under the direction of Rio Tinto (Northern Rhodesia) Ltd. as Consulting Engineers is in progress. By October, 1957 the use of helicopters had enabled the mapping of the area of 2,500 square miles to be completed, and in addition to direct geological examination magnetometer, scintillometer and soil-sampling surveys were carried out. Although indications of many minerals were obtained, none has so far proved to be economic, but it is planned to carry out a programme of more detailed prospecting in the northwest part of the area, where certain stronger anomalies have been detected.

KENTAN GOLD AREAS LTD.

The principal interest of Kentan Gold Areas Ltd. consists of a 78.63 per cent holding in Geita Gold Mining Co. Ltd., a private company incorporated in Tanganyika Territory, which holds mining leases over the Geita, Ridge 8 and Mawe Meru Properties covering an area of about 11¼ square miles, also 12 claims covering the lode at Prospect 30, and 32 claims adjacent to and in the vicinity of the other properties, and a Special Exclusive Prospecting Licence covering an additional 123 square miles surrounding the mining leases and claims. New Consolidated Gold Fields Ltd. act as Consulting Engineers and Technical Managers.

During the period from June, 1956, Kentan Gold Areas Ltd. and New Consolidated Gold Fields Ltd. have advanced a total of £475,000 in order to complete a reconstruction programme at the mine and in the endeavour to ensure that it was adequately equipped to operate on a profit-earning basis. However, losses have continued to increase, due almost entirely to low metallurgical recovery and investigation of this difficulty is in progress.

NORTHERN RHODESIA EXPLORATION

The company has undertaken to contribute 30 per cent of the exploration expenditure incurred by Rio Tinto (Northern Rhodesia) Ltd. in certain areas covering appjroximately 12,000 square miles over which the latter company holds exclusive prospecting licences in Northern Rhodesia, and is entitled to a 30 per cent participation in any discoveries made. The programme of exploration is being actively continued.

The Zambesia Exploring Co. Ltd.

THE Zambesia Exploring Co. has a continuous history of mineral exploration and exploitation going back to its formation in 1891. Tanganyika Concessions was formed by "Zams" in the last year of the last century and a sugstantial holdings in "Tanks" still represents the keystone of "Zams" investment interests.

The Zambesia company's operations and shareholdings run on three wheels: Zambesia Exploring itself, a finance company, Zambesia Investment Co., a wholly-owned subsidiary, which is an investment company, and Tanganyika Holdings, owned in equal proportions by "Zams" and Tanganyika Concessions.

At the end of "Zams" own financial year in March last year the parent company's portfolio consisted, apart from the two subsidiary companies mentioned above, of stocks and shares to a market value at that date of £582,123. This was somewhat lower than at the previous year-end, but remains well above the book value of £333,171.

Zambesia Investment is the main portfolio-holding company of the group. A substantial interest of 600,000 ordinary stock units of 10s. each in Tanganyika Concessions accounts for the lion's share of the £2,440,812 total market value of the holdings, but other investments include 15 per cent of the equity of Kentan Gold Areas at slightly above nominal value, and a small holding in Rhokana Corporation.

Tanganyika Holdings not only has a substantial investment portfolio, but carries on an exploration programme and provides office accommodation and secretarial services for the other companies of the group. Taking the portfolio first, this had a market value at June 30, 1956 (the time-lag is due to a difference in accounting dates) of £690,838. Included in this is a considerable interest in Kentan Gold Areas, a holding of 6.61 per cent in Kansanshi Copper, and an investment, the size of which is undisclosed, in Rhodesia-Katanga Co. which, in turn, owns a substantial proportion of Kansanshi's equity.

Tanganyika Holdings' exploration activity is at present represented by a participation in the intensive prospecting over 12,000 square miles of Northern Rhodesia which is being carried out by the Rio Tinto group. Tanganyika Holdings will be entitled to a 30 per cent interest in any flotation in return for providing a similar proportion of the expense incurred. Zambesia Exploring is contributing half of the funds needed by Tanganyika Holdings for the programme, and in order to meet this commitment "Zams" last year issued their remaining authorized capital, bringing the total of stock in issue to £1,000,000 in £1 units. The opportunity was taken at the same time of increasing the authorized capital of £1,500,000.

The table printed below gives the group results for the last five accounting periods, and shows the sound position that has been built up despite a generous policy of distribution.

ZAMBESIA EXPLORING CO LTD.

Period	*Profit from Sale of Investments* £	*Other Income* £	*Total Income* £	*Expenses* £	*Profit before Taxation* £	*Taxation* £	*Profit after Taxation* £	*Dividends Paid* £	*Total Reserves (including carry-forward)* £
Year to Dec. 31, 1953	76,740	115,031	191,501	10,814	180,687	109,286	71,401	71,390(15%)	495,729
15 months to March 31, 1955	Dr. 23,700	346,262	322,562	14,291	308,271	141,564	166,707	107,733(22½%)*	557,661
Year to 1956	46,366	157,023	203,359	12,874	190,485	101,456	89,029	91,428(17½%)	605,832
Year to March, 1957	58,442	197,814	256,256	12,661	243,595	134,968	108,627	109,713(20%)	676,079
Year to March, 1958	72,111	205,520	277,631	13,326	264,305	147,444	116,861	115,000(20%)	691,193

*Equivalent to 17.6 per cent for 12 months.

Selection Trust Ltd.

SELECTION TRUST is one of the principal mining finance companies known in the London market, but unlike most of the others it does not depend mainly on gold for its prosperity. Indirectly it is concerned in the production of nearly a score of different minerals, but much the more important of these have been copper, lead and zinc. This fact helps to explain an exceptionally rapid growth of earnings during the first half of the present decade, but it does of course increase the liability to fluctuations in earning power. However, molybdenum now represents quite an important interest, as a result of the merger of the American Metal and Climax Molybdenum companies referred to later, and this will be a stabilizing influence.

Although the Company is usually identified with the Rhodesian copper industry, its direct interest in the copperbelt is very small, most of the income from this source being derived at second hand through American Metal. Up to the end of 1957 Selection Trust held approximately 25 per cent of the issued common shares of American Metal, but as from January 1, this year, when that company amalgamated with Climax Molybdenum on a share exchange basis, Selection Trust's participation in the enlarged company (renamed American Metal Climax) has become 12.4 per cent of the 14,153,000 outstanding shares, or 1,751,797 shares. This investment is currently worth over £12,000,000 and probably accounts for about two-thirds of the marketable investments held by Selection Trust.

American Metal Climax is organized in three main divisions. It produces a wide variety of minerals both on its own account and from concentrates bought from other mining companies. It is also engaged in the search for, and the development of, new sources of minerals in the North American continent. Finally it has a portfolio of investments, of which the more important are considerable shareholdings in Rhodesian Selection Trust and Roan Antelope Copper.

Through the merger with Climax Molybdenum, shareholders of A.M.C. have an interest in the Free World's largest single source of molybdenum, a metallic element used primarily as an alloying metal to increase the strength and hardness of iron and steel, but with potentially important outlets in the electronics industry. Because of the expansion of the U.S. steel industry over the years to mid-1957 Climax was able to increase its sales rapidly and to achieve comparable financial results. Molybdenum prices are not subject to variations in business confidence to the same extent as the base metals, and for that reason the inclusion of Climax in the American Metal organization should lead to greater stability of earnings.

American Metal Climax's interest in Rhodesian Selection Trust is 50.61 per cent, giving it an approximate participation of 32 per cent in the Mufulira mine and a similar interest in the new copper-cobalt Chibuluma mine in Northern Rhodesia. A.M.C.'s ownership of the capital of Roan Antelope is 32.65 per cent, and through the American company Selection Trust is therefore interested to the extent of about 4 per cent in all three mines. It will have a similar stake in the earnings of the Baluba and Chambishi properties as and when conditions permit the equipment of those mines for production.

Another of A.M.C.'s major interests is 28.5 per cent direct and 1.87 per cent indirect of the capital of the Tsumeb Corporation, a company producing around 80,000 s.tons of lead and smaller quantities of copper, zinc and cadmium in South-West Africa. It also owns 37½ per cent of the capital of San Francisco Mines of Mexico, which supplies the greater part of the concentrates for A.M.C.'s refining operations in Mexico and Oklahoma, and it holds 19.72 per cent of the capital of O'okiep Copper, which produces about 30,000 s.tons of copper annually from its mines in Namaqualand, South Africa. Other A.M.C. participations include 29.41 per cent of Mazapil Copper, 17.51 per cent of Copper Range Co., owning one of the largest copper orebodies in the U.S.A., and 7.2 per cent of the capital of British Aluminium. A.M.C. operates an 84.07 per cent-owned subsidiary, Climax Uranium, which is engaged in mining and processing uranium and vanadium bearing ores in Colorado. It has also entered the oil and gas fields, concentrating for the most part on the acquisition of interests in proven and partly-proven fields.

American Metal Climax and Selection Trust also have linked interests in the production of lithium from the Bikita property in Southern Rhodesia. Selection Trust owns 40 per cent directly and about another 2.6 per cent indirectly through A.M.C. ownership of 21.25 per cent of the Bikita capital. Bikita ships lithium ores to American Lithium Chemicals, in which it has a 49.9 per cent voting interest, for processing into virgin lithium hydroxide which is supplied under contract to the U.S. Atomic Energy Commission. The principal commercial outlets for lithium are in the manufacture of lubricants and ceramics. The Bikita mine was financed partly by loans which must be repaid before dividends are declared, and this aspect of the group's operations is not therefore immediately important in terms of earnings.

Selection Trust has an important stake in the diamond mining industry through Consolidated African Selection Trust, in which it holds 4,349,092 shares, equivalent to 35.8 per cent of the capital; full information on this company's position and prospects will be found elsewhere in the *Review*. The Tsumeb Corporation also figures prominently in the group's direct investments, as well as through American Metal Climax, the shareholding being 570,000, or 14.25 per cent of the capital. The principal investments in the gold mining industry are in Vaal Reefs Exploration and Western Holdings, which are administered by the Anglo American Corporation of South Africa. The size of these investments is not stated, and it is probable that in relation to the interests as a whole they are small, but both are young mines which are providing an increasing return to their shareholders.

Selection Trust has been very active in recent years in exploration work in Canada, operations in the latter country being carried out by Selco Exploration, in which Selection Trust has a 65.6 per cent share. In all some hundreds of propositions have been considered over the past five years, of which more than 30 were regarded as promising enough to justify taking options while more detailed examination was made, but so far none has yielded results sufficiently encouraging to warrant proceeding to the development stage. The investment programme in Canada is centred in Selco Holdings, in which the parent company's interest is also 65.6 per cent. Selco Holdings' main investment to date has been in Western Decalta Petroleum, which owns a number of producing wells in Alberta and rights over extensive exploration areas.

As will be seen from the table below, Selection Trust's income and net profits increased by more than 50 per cent in the year to March 31, 1957. Broadly these results reflected peak earnings of the operating companies in which Selection Trust is interested. Copper had reached its all-time peak a year earlier and had declined steadily during the Trust's financial year, while lead and zinc also became cheaper though at a slower rate than copper, but there is, of course, a time lag between declines in the profits of the mining companies and their effect on the earnings of Selection Trust.

Profits announced quarterly by American Metal for 1957 are a clear indication that Selection Trust must be expected to report less favourable figures for the year to March 31, last. American Metal Climax earned $1.95 per share last year compared with $2.68 in 1956, and the dividend was reduced to $1.20 per share from the $1.75 paid by American Metal for 1956, or from $1.66 if the 1-for-20 scrip issue in 1956 is taken into account in comparing the two years' payments. The reduction in the American Metal dividend moreover occurred at the end of 1957 when the 60 c. extra dividend was omitted, and the decline will therefore be fully reflected in the 1957-58 accounts of Selection Trust. In addition, lower metal prices have compelled Tsumeb Corporation to reduce its quarterly dividend rate, and the loss of income arising from these two major investments will be made good only partially by larger revenue from the gold mining holdings. Selection Trust has, however, taken advantage of the good years to strengthen an already sound financial position, and it could well afford to distribute earnings less conservatively. Such a policy was no doubt in the mind of the chairman, Mr. A. Chester Beatty when he suggested that it should be possible to maintain the 7s. rate of dividend for 1957-58. That statement was made in June last year, however, and since then the base metal market has weakened to an extent that a decision to make a small reduction in the distribution would hardly call for criticism.

SELECTION TRUST LTD.
Consolidated Results

Year to Mar. 31	*Total Revenue**	*Taxation*	*Net Profit*	*Ord. Dividends*	*To Reserve*	*Carry Forward*
	£000s	£000s	£000s	£000s	£000s	£000s
1957	4,643.5	2,344.8	2,221.9	995.1	1,152.5	664.3
1956	3,083.9	1,557.7	1,433.3	812.3	452.5	595.8
1955	2,204.1	1,032.8	1,102.1	636.3	402.5	453.2

* Including profits on sale of investments: 1957, £2,290; 1956, £94,613; 1955, £176,788.

Consolidated African Selection Trust Ltd.

IN the final analysis the results achieved by Consolidated African Selection Trust in the year to June 30, 1957, were very similar to those for the previous year, but major changes occurred in the composite items, a decline of 18 per cent in mining profits being offset by an advance in income from trade and other investments and by a small reduction in the taxation charge. The net profit for the year covered the maintained dividend of 5s. per stock unit with a small margin, but it is worth noting that credit was taken for estimated double taxation relief on the investment income of the year whereas previously this relief was credited in the following years. This change of procedure increased the net profit by about £110,000. Excluding this adjustment the dividend was short-earned by about £100,000, but the distribution must be considered in the light of the extremely strong financial position which has been built up over the years. The consolidated balance sheet shows net current assets of almost £5,600,000 or more than 9s. per share on the 12,100,000 shares outstanding following the 100 per cent capitalization issue in December, 1957.

Despite its declared policy of mining ground of lower average grade and thereby extending the life of the mine, C.A.S.T. recovered in Ghana much the same quantity of diamonds as in the previous year although in order to do so the yardage of gravel treated had to be increased by more than 25 per cent. In continuation of this policy, construction has started on a new washing plant which is estimated to cost about £800,000 and will treat approximately 300,000 cu. yd. per annum. In Sierra Leone a greater yardage was also treated and a larger caratage of stones produced. Illicit mining continued to take place within the boundaries of the concessions and in last August there was a serious breakdown of law and order in the district. The situation has, however, since improved, and the Sierra Leone company has expressed its long-term confidence in the prospect by spending £550,000 on a new and separate plant the benefit of which will be felt during the financial year 1958-59. Both in Ghana and in Sierra Leone, the group is spending large sums on technical training schemes in order to fill an increasing number of position of responsibility with Africans.

CONSOLIDATED RESULTS

Year to June 30	*Total Mining** £ (000)	*Revenue, Divs., etc.* £ (000)	*Taxation* £ (000)	*Net Profit* £ (000)	*Dividends* £ (000)	*To Reserve* £ (000)
1957	1,441.5	923.7	1,320.0	876.9	872.0	100.0
1956	1,754.4	656.4	1,385.7	861.4	872.0	Nil
1955	1,738.8	492.0	1,174.7	892.7	654.0	351.9
1954	1,914.7	443.7	1,412.0	815.9	625.6	380.5

*After providing for Ghana minerals duty: 1957, not stated; 1956, £268,701; 1955, £191,813.

NEW TAX STATUS

A highly important development during recent months has been the conclusion of arrangements enabling the company and its subsidiary, Sierra Leone Selection Trust, to qualify as overseas trade corporations from January 1, 1958. One effect will be that £290,000 previously set aside for U.K. income tax will no longer be required for that purpose, but apart from this non-recurring advantage, there will be an annual saving the precise amount of which cannot be calculated but which will clearly be substantial. In future C.A.S.T. and S.L.S.T. will not be liable to U.K. profits tax on trading profits (as distinct from investment income), and U.K. income tax will be payable on dividends declared only to the extent that it is not relieved by overseas taxation. Unfortunately the replacement of the Ghana minerals duty by a profits tax which would rank for double tax relief in the U.K. has not yet been effected by the Ghana Government.

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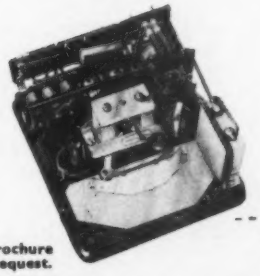

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Ghana

Ashanti Goldfields Corporation Ltd.

FORMERLY the Gold Coast, what is now known as Ghana was granted independence early in 1957. Since that time serious doubts have been voiced from time to time about whether the Prime Minister, Dr. Nkrumah, and his African associates forming the present Government, could command sufficient experience and savoir-faire as to take such an independent Commonwealth State through to mature nationhood without the many trials and errors commonly associated with the rebirth of nations.

Much of the criticism may well have been needlessly aggressive if not, indeed, exaggerated. But over the period concerned, it has gradually had the cumulative effect of quenching any enthusiasm there may have been for investment in Ghana.

More recently evidence has been accumulating which has suggested that many of these misgivings, which may still be widely held in some quarters, will prove groundless. On more than one occasion in recent months officials speaking for the Ghana Government have been at pains to refute any suggestion that it has been in their minds to nationalize the gold mining industry.

It is becoming increasingly clear that the present Ghana Government appreciates only too well the dependence of the gold mining industry on European technical know-how and management on the one hand and of the importance of maximizing the country's gold production in view of balance of payments problems on the other. By common consent, there would be small chance of maintaining maximum efficiency and production in the industry for any length of time if European labour and guidance were to be wholly withdrawn.

This preambling sketch is necessary for any understanding of the position and prospect of any of the individual Ghana gold mines. It is more than ever necessary in considering the outlook for the new State's biggest, oldest and richest gold producer—Ashanti Goldfields Corporation.

Major-General Sir Edward Spears has been chairman of the corporation for many years past. He has spared no effort to get to know the country, the people in it and those who are now running it. Sir Edward is no pessimist when it comes to Ghana's future or, for that matter, that of Ashanti Goldfields itself.

At the annual meeting earlier this year, Sir Edward has been able to give what must be considered a reassuring account of the position in Ghana so far as industry run from abroad is concerned. "There is no doubt," Sir Edward has said, "that Dr. Nkrumah's Government is in a stronger position than it was a year ago and is gaining in power. Anyone who has had dealings with Ghana's leaders cannot fail to be impressed by their intelligence, and delighted by their courtesy."

Sir Edward's interpretation of the Ghana outlook should be as reliable as any and better than most. And it is from this starting off point, after the uncertainties of the past few years, that a fresh assessment of the Ashanti Goldfields' outlook can fairly be made.

After the strike of African labour which lasted for three months from the end of 1955 into 1956, there has been a natural tendency for the whole of the labour situation to become suspect. During the past year—and indeed, since the strike ended more than two years ago—there has been every indication of more stable labour conditions than for a long time past. Sir Edward Spears has described relations during the past year with the mine employees' Union as being "co-operative and helpful." The industry, however, has insisted that there shall be no "closed shop" and that the individual worker's freedom to join the Union or not will be absolute and guaranteed by adequate supervision including that of the company's management. Meanwhile, as from March 15, agreement has been reached with the Union on the question of deduction of union dues at source together with wage increases effective from February 1.

Sir Edward has described the wage increases as inevitable in view of the increases already given to employees in the Ghana Government service.

In technical and financial terms Ashanti itself has completed an exceptionally good year during the twelve months to September 30, 1957. During this period, the mine milled a record tonnage of 338,727 tons and its gold output at 275,217 oz. was also a new peak in the long history of the mine. The previous highest gold recovery was in 1939-40 and the previous highest tonnage milled was in 1954-55. The past year's results in terms of gold production may be attributed to a number of factors.

In part they have been a reflection of the policy of reconstruction and modernization which has been carried out at the cost of considerable capital expenditure over a number of previous years. Companies in Ashanti's position immediately after the war thus found themselves faced with the necessity of carrying out considerable rehabilitation programmes.

On top of this labour was becoming sharply more costly, trade unionism was becoming a factor and European labour recruitment remained difficult. As the record of the early post-war years shows, gold production had to suffer a temporary cut while other longer-term factors were given attention. The long term programme aimed at providing an adequate deep-level shaft system, expanded forward development and a treatment plant with improved metallurgical efficiency.

In carrying out this programme over recent years the question of finance in difficult market conditions has been an all-important one. In fact, this programme has involved Ashanti in heavy capital expenditure programmes over the past 11 years on the sinking and equipment of shafts alone. A major project has been the completion of the Eaton-Turner shaft, this being an 18 ft. diameter circular shaft down to a depth of 4,354 ft. The completion of this shaft during the past twelve months has meant the provision of adequate ventilation at the bottom levels of the mine together with hoisting facilities for both waste and rock. Meanwhile, it is also worth recording that it has been found possible to increase the capacity of the treatment plant without loss of metallurgical efficiency and that there has also been a marked improvement in African labour productivity.

It can be easily appreciated that for a number of years past it has been necessary for Ashanti Corporation to plough back a considerable proportion of its profits for capital expenditure. The company has had to bear an undue burden of taxation. As a U.K. undertaking operating abroad, Ashanti has now qualified as an Overseas Trading Corporation, and will benefit accordingly from the appropriate provisions of the U.K. 1957 Finance Act. But as Sir Edward Spears has lately emphasized, taxation in Ghana itself is still very high, company tax being in fact at the rate of 9s. in the £. "The Government of Ghana" says Sir Edward, "which is so realistic in its outlook, might well ponder the fact that it is not the natural resources of the world that are in short supply but rather the capital to exploit them."

The accompanying table shows the extent of Ashanti's recovery during the past year after the serious effects of the strike during 1955-56. Of even more importance—certainly so far as the future is concerned—is the fashion in which the Main Reef has been developing at depth during the past year. Since the longer term future of the main Ashanti mine will depend substantially on this ore-carrier, which represents a merging of the Cote d'Or and Obuasi reefs at around the 2,200 ft. level, too much importance cannot be placed on the character of Main reef development results on the lower levels.

OPERATING RESULTS

Year to Sept. 30	*s.tons milled (000)*	*Grade (dwt.)*	*Yield (oz.)*	*Cost* per ton s. d.*	*Bullion† Proceeds £*	*Other Income £*	*Mining Costs £*	*Other Costs‡ £*	*Taxation§ £*	*Pension Fund £*	*Free Balance £*	*Dividend %*	*To Reserves £*	*Ore Reserves Tons (000)*	*Grade (dwt.)*
1957	338.7	18.24	275,217	77 4	3,419,806	52,974	1,542,097	261,272	879,756	16,119	789,650	37½*a*	360,332	1,450.0	19.11
1956	215.5	19.21	183,707	100 2	2,286,468	31,218	1,291,852	272,434	516,608	18,149	236,792	35	60,230*b*	1,869.7	17.6
1955	310.9	14.45	196,236	69 4	2,466,101	33,579	1,288,056	234,287	500,892	17,108	476,445	20	315,753	2,021.7	16.1
1954	297.7	14.36	192,494	71 6	2,374,823	41,615	1,278,420	216,047	568,355	16,609	353,616	40	62,325	2,212.9	16.2

*Excluding development charges. †Less realization charges. ‡Depreciation and General Expenses. §Including Ghana Government Royalty and Gold Duty.
(*a*) Year's total adjusted for 1-for-2 scrip issue in which only final dividend ranked. (*b*) Taken from reserve.

In recent months some crosscuts have been put out for the first time on the 41st level and these have already suggested that this orebody is continuing strongly downwards in terms of both magnitude and grade. On the immediately higher levels development over the past year or more has been similarly encouraging. It will probably be some time ahead before much stoping is likely to be done on this bottom level. But meanwhile, primary development will doubtless continue to open up the bottom of the mine.

For the immediate future it might be too optimistic to look for an appreciable increase in the average grade of ore treated. The milling plant is already working virtually to capacity. Profits for the current year, other things being equal, may be much in the region of those obtained during 1956-57. There remains capital expenditure of around £1,000,000 to be met during the next three years, three-quarters of which will be spent during the current year. The prospect is therefore that for 1957-58 dividends will be roughly held at around last year's level. Thereafter, there will be the possibility of a gradual increase in the grade of ore milled as more material starts to be drawn from the lowel levels. At the same time capital expenditure requirements should start to put a less heavy drain on liquidity.

Bibiani (1927) Ltd.

IT is not, unfortunately, possible to wax as enthusiastic about the prospects for Bibiani (1927) as it is for Ashanti, although both companies are in the same stable. Both before the war and since there have been occasions when Bibiani's technical outlook has seemed to be more promising. But this has remained essentially a low-grade gold operation and the company, generally speaking, has had to face the problem of rising costs on the one hand and a not over-generous ore supply position on the other.

Within its limitations, the mine's performance last year was, indeed, commendable. The mill handled the record tonnage of 372,000 tons and despite a fractional decline in the average head value of ore treated, gold yield during the year concerned advanced to 78,000 ozs. It is also notable to record that during the same period working costs per ton were brought down to 42s. 2d. against 48s. 1d. in the previous year, when admittedly they were inflated by the effects of the strike.

In earlier years we have referred to the manner in which the Bibiani tonnage has been helped by gold bearing material derived from its surface quarries. Last year's record tonnage milled was derived as to 77.5 per cent from underground sources, but quarry ore still accounted for the balance of 22.5 per cent. Surface material is of lower grade—say 4.3 dwt. per ton against 5 dwt.—than underground ore but it makes an important contribution to the mill feed. It may not always be realized how important is the question of ore supply in Bibiani's position. In the year to September 30 last as much as 89 per cent of ore from stoping and stope preparation came from the ore reserve. Anything that can modify this figure such as the mining of quarry ore can only be welcomed in a technical sense. It is now estimated that the South quarry will be able to continue at the present rate of production for another four years.

For all this there still remain doubts about the technical outlook for the Bibiani mine so far as the main orebody is concerned. Recent development has been devoted mainly towards the exploration of the orebody at the southern end of the mine between Nos. 18 and 21 levels and between Nos. 12, 13 and 15 levels on the northern orebodies. Lenses have been proved to persist between Nos. 19 and 21 levels and current work should be able to prove whether or not the downward projection carries on the No. 24 level. At the meeting in April last, Major General Sir Edward L. Spears, the chairman, was still only able to report that "results of development to date continue to be disappointing."

An interesting characteristic of the new orebodies developed on and below the No. 19 level was the fact that they were of relatively small size but of much higher grade than those accounting for the bulk of the existing ore reserve.

As at September 30 last, Bibiani ore reserves declined slightly to 1,335,000 tons, the average grade being lower by 0.45 dwt. at 5.04 dwt. gold per ton. Thus the trend established in earlier years has been continued. It is evidently becoming more and more important that major new ore discoveries should be found if the longer term future of the mine is to be assured. Indeed, the last annual report says as much. The main objectives of the current year's programme is the exploration of the reef zones to the south and to the north on the Nos. 21 and 24 levels. For the present, ore reserves are barely equal to four years' supply to the mill.

Bibiani's financial position meanwhile, may derive some benefit from assistance from the Ghana Government. The Company has been obtaining some help from the two-year subsidy scheme which comes to an end in June and under which the Company has received an annual payment of approximately £30,000. This subsidy was granted, it will be recalled, in order to enable certain low-grade gold mines in Ghana to meet African wage increases. This year a further wage increase has been agreed as from February 1. Bibiani with other low-grade mines has made a new approach to the Ghana Government, for a renewal of the subsidy but the last published information on this point was that the Government was only prepared to make the Company a loan. This, as Sir Edward Spears has emphasized, would be unacceptable to the Company, since it would not have been in the interests of shareholders. It is hoped, meanwhile, that some subsidy scheme will be devised and agreed upon by the Ghana Government, rather along the lines of the Australian or Canadian models.

Bibiani's financial position will be helped to some extent by its qualification as from April 1957, as an Overseas Trading Corporation in terms of the U.K. Finance Act 1957, an annual tax saving of the order of £15,000 being involved. Additionally, capital expenditure requirements are being kept to a minimum and the Company's net liquid position is reasonably good after the setback which occurred through the labour strike of 1955-56. At the end of September 1957, net current assets had increased from £431,000 to £538,000. For the more immediate future there is every prospect of the mill tonnage being more than maintained at last year's level and, by 1959, a considerable tonnage of low-grade ore will become available for mining as the result of current work being done in re-opening several of the old upper levels of the mine. But thereafter, the future of the mine will depend on the discovery of a major new orebody. If the position has not improved by 1959 a gradual reduction in output will, the chairman has said, eventually become unavoidable. But this conclusion is not inevitable. And, in any case, it is expected that the present level of gold recovery can be maintained for the next three or four years.

OPERATING RESULTS

Year to Sept. 30	*s.tons milled* (000)	*Grade* (dwt.)	*Yield* (oz.)	*Cost* per ton* s. d.	*Bullion† Proceeds* £	*Other Income* £	*Mining Costs* £	*Other Costs* £	*Taxation‡* £	*Staff Assurance Fund* £	*Free Balance* £	*Dividend* %	*To Reserves* £	*Ore Reserves Tons* (000)	*Grade* (dwt.)
1957	371.8	4.7	77,992	42 2	976,034	11,159	783,210	92,219	40,400	7,025	64,339	10	25,894	1,335.5	5.04
1956	259.2	4.8	57,382	48 1	714,876	9,099	623,631	92,978	Nil	7,901	Dr.535	Nil	7,328§	1,392.0	5.5
1955	366.6	4.4	75,414	38 8	946,459	10,029	708,956	93,662	66,500	7,435	79,935	5	65,560	1,481.0	5.6
1954	350.6	4.8	77,818	41 8	958,763	10,163	729,940	91,001	74,694	6,273	67,018	10	39,518	1,783.5	5.4

*Including development charges. †Less realization charges. ‡Including gold duty paid to the Ghana Government. §Taken from reserve.

Western Selection and Development Co. Ltd.

THE reports which follow of the Ghana gold mining companies operating under the aegis of Western Selection and Development Co. Ltd. show a marked improvement in the present profitability of the companies and give good reason for renewed confidence for the future. The difficult period experienced after the protracted strike of African mineworkers has now passed and development results fully warrant the increased expenditure on ore development. Labour relations are now extremely good and an atmosphere of co-operation and understanding now exists. The policy of the Ghana Government towards the Mining Industry has been one of consideration, in that having already given the lower grade mines a grant of £200,000 they have now decided to appoint an independent mining expert to report on the state of the gold mining industry in Ghana with a view to passing the necessary legislation to help or subsidize low grade mines.

In addition to this Company's major interests in Ghana it has continued to finance its Canadian projects. The greater interest now shown in Canada in gold mining has given new impetus to the Company's gold mining leases in Ontario. Cordoba Mines Ltd., the Canadian Co. formed to prospect and develop these leases, has continued its geophysical and geochemical surveys and further diamond drilling to test known anomalies is at present being carried out.

In Manitoba the Tow Lake leases have been incorporated into another Canadian company, Genrico Nickel Mines Ltd., to develop the copper/nickel deposits outlined last year. Further intensive electromagnetic and geophysical surveys have been carried out and a new diamond drilling programme is planned to investigate the most favourable areas. In its widely divergent interests covering the old world of Africa and the new world of Canada lies the future of the Company. Having pioneered so many important gold discoveries in West Africa it is in keeping with its role of a mining finance Company that it should do the same in Canada.

AMALGAMATED BANKET AREAS

From the quarterly reports published by Amalgamated Banket Areas it is quite clear that the company has been doing very much better in the financial year to September 30, 1957, than in the previous year. This is not surprising for 1955-56 was clouded by the African strike which lasted for three months. Probably a better standard of comparison is between the experience of the latest year and 1954-55. If this be done, the result is rather less encouraging for whereas working profits in the earlier year amounted to £416,853, in the latest year they came to only £301,561.

These working profits make no allowance for depreciation, ore development expenditure, or a number of other, smaller items which figure in the usual profit and loss account; nor do they include any credit for income from other sources, which normally varies quite considerably. This qualification suggests that the 1956-57 net profit might differ radically from that of 1954-55.

The prospects of earnings in 1956-57 failing to measure up to the standard of 1954-55, is rather more disappointing as the grade or ore treated has risen appreciably. Since the strike, the recovery grade has been in excess of 4 dwt. per ton, but the average grade treated in 1954-55 was only 3.3 dwt. This has brought in an additional revenue of at least 8s. 9d. per ton, but some of that advantage has been lost because the quantity of ore treated in the mill during 1956-57, was only 697,531 tons, roughly two-thirds of the 1954-55 tonnage. Since the war ended the mill throughput showed a steady, substantial increase up to 1954-55, partly under the influence of treating low-grade ore from the Pepe open-cast workings.

During 1955-56, the payable and easily worked benches became exhausted, and though efforts were made to discover more payable ore, they were not successful and the decision was taken to cease production at the workings. Over one-third of the total ore milled used to come from Pepe, so that this decision to close was a major one. The ore had, however, a grade of rather less than 1.5 dwt. per ton as compared with 4 dwt. and above for the other sections. The cutting out of the Pepe ore brought an automatic improvement, but this has been nurtured quite deliberately.

In the December 1957, quarter, the recovery grade had risen to 4.40 dwt. per ton and this has been reflected in better profits. The working profit of that quarter of £108,040 is equal to an annual rate of £432,000, which is roughly comparable with that actually earned in 1954-55. Against this background it would seem that 1956-57 should be considered as a transitional year, even though it was some distance removed from the African strike.

The last few quarterly reports have shown a tendency for expenditure on capital projects to contract; it might not seem to be very much since this expenditure has fallen from £13,390 in the June 1957, quarter to £8,251 in December. It is nevertheless, of some assistance.

ARISTON GOLD MINES (1929) LTD.

The increase in the amount of ore sent to the mill by Ariston Gold Mines over the past few years, interrupted only by the set-back in 1955-56 occasioned by a lengthy strike of African workers, was carried on into the year to September 30, 1957, when 470,520 tons were treated. Although the general tendency recently has been for the grade of ore to fall, this has been at a slower rate than the growth in tonnage, with the result that the number of ounces of gold has tended to grow. In 1956-57 it was 145,344 oz.

Costs and tax have done their work on net profits, though the latter will be restricted now that Ariston has chosen to become an overseas trade corporation as from April 5, 1958. As a result, the board paid, with the 1956-57 final of 5 per cent which made a total for the year of 10 per cent, an interim dividend of 15 per cent for 1957-58, and a bonus of 10 per cent, the three dividends being paid on April 1. Further dividends will thus be payable out of profits earned after the company has become an O.T.C.

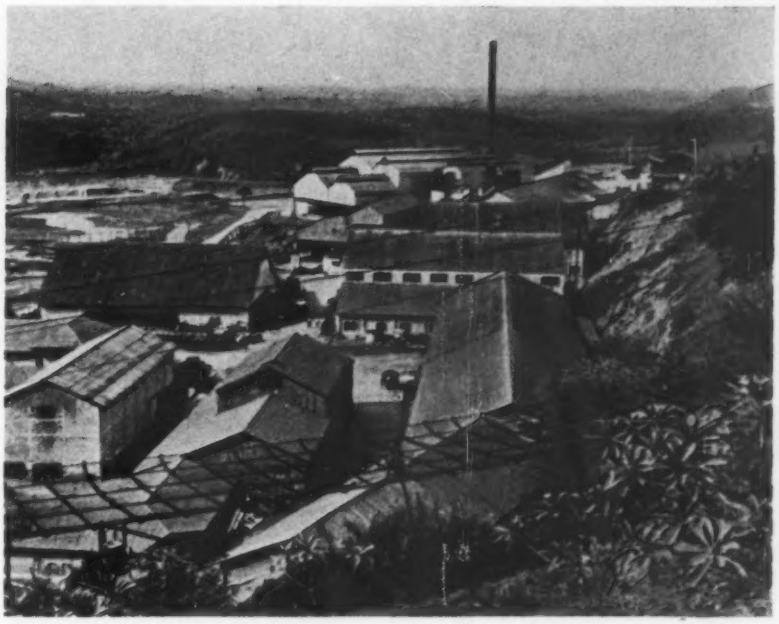
For some years past, Ariston has been engaged on proving the orebodies at depth, and plans have been laid for the next three years or so. Financially, it means that a considerable part of the year's profits must be put back into the property, but it will assure the future of the mine. At the end of last September, available ore reserves amounted to 2,250,000 tons, equal to roughly five years' supply to the mill at the current rate. This is not unsatisfactory, but it will be increased after the development programme is complete.

Tonnage-wise, most of the ore reserves are in the No. 2 orebody, where it is planned to open up from the present No. 26 level to No. 30. By September 1959, it should be possible to have a very fair idea of how the reef behaves between the

OPERATING RESULTS FOR THE GROUP'S PRODUCING MINES IN WEST AFRICA

Company	*Year Ended*	*Tons milled (000)*	*Grade (dwt.)*	*Yield (oz.)*	*Cost** per ton* s. d.	*Bullion† Revenue* £	*Other Income* £	*Mining Costs* £	*Other Expenses* £	*Gold Duty* £	*Tax* £	*Net Profit* £	*Dividend* %	*Carry Forward* £
Amalgamated Banket Areas	30.9.57	698	4·2	142,956	49 9	1,782,645	47,264	1,539,595	290,324	Nil	Nil	35,730	Nil	L161,278
	30.9.56	634	3·5	105,684	40 4	1,313,894	16,603	1,145,089	391,292	Nil	Nil	L205,884	Nil	L163,514
	30.9.55	962	3·3	149,884	32 11	1,867,741	1,129	1,450,888	256,821	Nil	Nil	119,405	10	85,683
Ariston Gold Mines	30.9.57	471	6·8	145,344	56 5	1,801,486	4,998	1,220,226	342,091	Nil	131,698	244,167	10	145,386
	30.9.56	327	6·3	90,173	53 1	1,122,499	6,280	903,505	174,958	Nil	21,557	28,759	5	82,532
	30.9.55	456	6·6	132,562	49 8	1,652,768	10,053	1,065,082	198,787	18,500	174,178	206,274	10	80,297
Bremang Gold Dredging	31.12.56	8,455‡	2·68§	43,139	0 11*	538,886	5,526	397,570	72,252	Nil	4,137	74,590	5	56,517
	31.12.55	8,221‡	2·50§	39,330	0 11*	493,391	2	366,556	64,058	Nil	4,218	62,779	5	44,050
	31.12.54	6,335‡	2·42§	29,240	1 0*	363,215	6	323,860	46,491	Nil	3	7,130	Nil	1,517
Ghana Main Reef	30.6.57	142	7·8	47,568	70 3	595,381	18,093	444,047	91,582	Nil	1,787	77,846	Nil	61,362
	30.6.56	83	8·2	29,686	78 11	369,024	4,911	344,995	68,960	Nil	1,340	L40,020	Nil	L15,584
	30.6.55	114	8·6	43,995	75 6	548,674	2,769	383,609	87,193	Nil	41,098	39,543	5	25,776

**Including development charges. ‡Cu. yd. §Grains recovered per cu. yd. *Per cu. yd. †Less realization charges. L=Loss.



The Workshop Area at Ariston Gold Mines

two levels, though a further couple of years must elapse before the ore is blocked out to be included in the reserves.

Much of the same sort of time-table is programmed for the North orebody, which has the next largest tonnage of ore reserves, and these are of higher average value than at No. 2. In each case the present shafts or winzes are being extended to the 30th level; the No. 4 winze which will help explore the No. 2 orebody is planned to go later on to 40 level. Once the 30th level has been reached on these two orebodies, drives will be made to the so-called Main orebody without the expense of extending the No. 1 winze. Presumably, that will be done if the results should warrant it.

BREMANG GOLD DREDGING

Unlike other companies in the group, Bremang's method of recovering gold is by dredging for alluvial deposits in river areas. It has largely worked out its concessions on the Ankobra River and it has transferred three of its dredges across to the Offin River area; a fourth dredge will be moved in the near future. The transfer of these dredges, involving dismantling, transporting and re-erecting, has been costly, the financial outlay being aggravated by the loss of income while the dredge has been out of action. The experience gained from the transfer of the earlier dredges served the company well during the move of the third, and there is every reason to expect that the fourth will be moved smoothly and quickly. The heavy financial burden has been relieved to some extent by a particularly sharp reduction in tax liabilities.

Capital expenditure during 1957 amounted to £153,892 as compared with the working profits total of £152,425, but the quarterly reports show an encouraging trend, expenditure in the fourth quarter of the year being only £4,493 against £64,705, in the first quarter and working profits were growing generally through the period. Although the company qualifies for the special Ghana Government grant, which will be reviewed during the current year, the payment has been omitted in these calculations of working profits. The payment of a 5 per cent dividend for 1956, and the capital spending has meant eating into reserves; but these had been specifically built up for that purpose. After the last dredge has been moved—planned to start in November 1958—dividends should expand, though it must be remembered that tax liabilities will eventually return to a more normal level. Although no official statement has been made, it seems likely that Bremang could opt to become an overseas trade corporation.

GHANA MAIN REEF LTD.

Although the strikes of African workers on the mines of the territory formerly known as the Gold Coast, but since renamed Ghana, ended in March 1956, its evil has long lived after it. Ghana Main Reef's financial position was weakened in order to keep the mine physically intact, but the last year or so has seen great strides made to recover its former strength.

During the year to June 30, 1957, the £28,000 loan from an associated company has been repaid, and a tax liability of almost £40,000 has been met. Net current assets over the year have improved from slightly over £170,000 to £252,000. The achievement was possible because the board decided, no doubt very reluctantly, to pay no dividend at all for 1956-57. This kept intact the comparatively small stock of cash; since the year-end it has been augmented by current profits, and the position has been improved to the stage where the payment of an interim dividend of 5 per cent for 1957-58 has been possible.

The expansion in the mill throughput which commenced in 1951-52, has raised the tonnage treated from 93,609 to 142,395 in the latest year. Thanks to an improvement in grade the output of gold has risen by over 50 per cent; this increase accompanied by a very successful attack on costs, despite inflationary pressures, has made its mark on profits, and with the better financial situation, shareholders can expect satisfactory returns.

News of the work underground continues to be encouraging: the Tuappim section which contains over one-half of the tonnage of the ore reserves, and is the richest of the three sections has given results officially described as "encouraging." On the 16 level, the Southern ore shoot gave 430 ft. at 11.66 dwt. over 121.7 in. Development on the Bondaye section has met with only moderate success, but, because of indications of more favourable results at depth, sinking has been resumed.

Ore reserves, at 371,201 tons, are equal to over 2½ years' supply to the mill at the present rate of treatment. While this is not an unsatisfactory figure, the ore reserves have not expanded at the same rate as the mill throughput. For this reason, part of the company's profits can be expected to be earmarked for development.

SUMMARY OF OPERATIONS SINCE DATE OF LATEST PUBLISHED REPORT AND ACCOUNTS

Company	*Period*	*Tons Milled*	*Yield*	*Grade*	*Bullion Revenue*	*Mining Costs*	*Working Profit*	*Capital Expenditure*	*Available Ore Reserves as at each Published Report*		
			(oz.)	(dwt.)	£	£	£	£	*Tons* (000)	*Value* (dwt.)	*Width* (in.)
Amalgamated Banket	6 months to 31.3.58	372,602	86,480	4·64	1,101,868	852,891	248,977	24,459	1,281·1	5·49	39·13
Ariston	6 months to 31.3.58	248,540	75,091	6·04	940,055	667,265	272,790	61,323	2,662·3	6·84	122·0
Ghana Main Reef ...	6 months to 31.3.58	104,086	36,640	7·04	469,639	348,931	120,708	23,836	371·2	8·5	77·0
Bremang	12 months to 31.12.57 3 months to 31.3.58	8,268* 2,445*	42,921 13,754	2·49† 2·92	537,618 171,543	385,193 108,819	152,425 62,724	153,892 9,501	63,942‡§ —	2·75‡§ —	— —

*Cubic yards. †Grains per cu. yd. ‡Thousand cu. yds. §Those are 1956 reserves and are exclusive of Jimi and Offin reserves.

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Those companies which were able to produce columbite between August 1952 and May 1955, or had forward contracts running until end-1956 obtained a great advantage. Some invested the proceeds in more columbite-producing equipment, some expanded or modernized their tin plants while others prospected the primary biotite granites on the Bauchi Plateau. For a time the tin-columbite producers were able to switch over to the greater production of tin in an endeavour to ameliorate the worst effects of the loss of revenue. This period, however, came to an end early this year when the impact of the tin restriction scheme made itself felt.

The Nigerian quota allocated in accordance with the voting power of the members of the International Tin Council bore rather more heavily on the Colony than elsewhere with the possible exception of Thailand. This quota was broken down into parts, and each individual mine given its own quota. In calculating individual quotas, shipments over the years 1950 to 1956 were taken into consideration. This helped the mine which, for some reason or other, had temporarily run into a bad patch. But it also worked the other way, for it made the quota relatively small in comparison with the existing output. The average cut in Nigerian production was bad enough, but those companies which invested their columbite funds in expanding tin production received an additional whack from the columbite stick.

Naturally, at such a time of restricted output, the companies' need was to be liquid. But the manager of the buffer pool has made the three calls for contributions which the Council authorized him to make in certain circumstances. This was not sufficient to keep the market buoyant, and in January the Council decided to establish a Special Fund to complete the work begun earlier. The size of the Special Fund is not known, a precaution taken, presumably, to prevent consumers from knowing the resources available at any given time to absorb any "surplus" metal coming on to the market. These various calls have locked up some of the companies' funds, for the contributions are not returnable until the pool is liquidated. Unless, therefore, the scheme collapses these funds are frozen for a an unknown period.

The sudden turn in events has resulted in the dismissal of numbers of native workers, who are dismayed at the manner in which prosperity has vanished. Accordingly, there have been agitations that Nigeria should withdraw from the Tin Agreement, an action which would almost certainly lead to the scheme's demise. Probably, wiser counsels will prevail, but it would not be surprising if, occasionally, there were not some widespread wishes that the 1952-55 boom in columbite had never occurred.

It is a little ironic that these companies having left the fat times behind should now be granted tax reliefs under the last two U.K. Budgets. The 1957 Finance Act provided for the establishment of Overseas Trade Corporations which would enable companies qualifying as such to escape the payment of some of the heavy imposts previously endured. The proposals made in the last Budget changed the basis of calculating profits tax and it seems that a large contingent tax liability might be abolished—an action which would certainly be of assistance were it ever found necessary to distribute past profits. In addition, under the last Nigerian budget, additional relief is given by lowering the standard rate of tax for companies from 9s. to 8s. in the £.

It is vain to regret that this legislation did not come earlier when profits were higher and the reliefs would consequently have been larger, but it would be unnatural to expect that a wistful glance back will not be made at what might have been. One point about the Overseas Trade Corporation provisions is that companies are not bound to accept that status, and in some cases, it has been found more advantageous to delay becoming such an "Overseas" corporation. Some mining companies are still calculaitng where the balance of advantage lies, and have as yet made no decision.

GOLD AND BASE METALS

Gold and Base Metals used the U.S. columbite proceeds to increase the mechanization of operations, and in the acquisition of new properties, thereby reducing costs on the one hand and extending the life of the mine on the other. Unfortunately, the boom was too short lived for shareholders to have received much benefit. Indeed, because the company borrowed in order to make these changes, the 1955 dividend was passed, and in 1953, 1954 and 1956, the dividend rate was 7½ per cent, comparing with the 15 per cent paid for each year between 1950 and 1952. The financial position of the company had been restored by the end of 1956, so that current assets, excluding stores in hand, exceeded current liabilities by a small margin. The chairman stated in July, 1957, that owing to the temporary advantages which the company was obtaining by way of tax allowances on capital expenditure, no immediate material benefit would accrue from becoming an O.T.C., and future benefits would depend on Nigerian tax rates and on dividends distributed.

Gold and Base is still reaping some benefit from the sale of columbite. It has sold forward "at a satisfactory" price 60 l.tons per annum until the end of 1958, and thereafter for a further two years at a price to be agreed. The output of tin concentrates during 1957 amounted to 1,059 tons as compared with 773 tons in the previous year, and production of columbite concentrates to 134 tons against 178 tons. Tin production in 1950 was only 553 tons, and not until 1956, did production exceed 600 tons. This gave Gold and Base a very poor average as compared with the then current output, and its quota, fixed at 112 tons for the first three-and-a-half months' period, was only slightly in excess of a month's output.

EX-LANDS

Ex-Lands Nigeria is the only "120" Group company not concerned with the production of columbite. In recent years its output of tin has been tending to fall. It never fell below 700 tons a year between 1947 and 1950, but since that time it has not exceeded that level. The company's ore reserves have kept remarkably steady. Output rose last year by about 6 per cent, but the lower average price received more than offset the increase. Since, however, the Annual Accounts are drawn up on a basis of shipments and not production, the results for the year cannot be reliably estimated particularly in view of possible benefits to be received as an O.T.C. Moreover, the directors will be obliged to have present conditions in mind when considering the 1957 dividend.

BISICHI TIN

Rising output and falling costs over the years, together with a substantial output of columbite, have given Bisichi Tin a quite impressive record in recent years.

The new conditions prevailing for both tin and columbite, however, will have drastic repercussions on profits. In 1956, for example, columbite was fetching a profit of £1,270 per ton on 299 tons. The end-1956 financial position was on the tight side, following the purchase of the Gombar property, and the payment of cash as part consideration for the acquisition of a majority holding in Naraguta Tin Mines.

The payment of further instalments to the buffer pool and the possible stockpiling of some concentrates will do nothing to help improve that situation.

UNITED TIN/RIBON VALLEY

At one time it was proposed to amalgamate the two companies, United Tin and Ribon Valley, but in the end no common basis was found. Ribon Valley, however, continues to hold a one-third interest in the Odegi area, owned by United Tin.

Ribon's output of tin in 1957-58 amounted to 222 tons, the same as in the previous year, but columbite production was only 2½ tons against 20½ tons. United Tin was not able to live up to those standards, its tin output being only 65 tons against 77½, and its columbite 5½ tons against 47¾.

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Gold and Base is still reaping some benefit from the sale of columbite. It has sold forward "at a satisfactory" price 60 l.tons per annum until the end of 1958, and thereafter for a further two years at a price to be agreed. The output of tin concentrates during 1957 amounted to 1,059 tons as compared with 773 tons in the previous year, and production of columbite concentrates to 134 tons against 178 tons. Tin production in 1950 was only 553 tons, and not until 1956, did production exceed 600 tons. This gave Gold and Base a very poor average as compared with the then current output, and its quota, fixed at 112 tons for the first three-and-a-half months' period, was only slightly in excess of a month's output.

EX-LANDS

Ex-Lands Nigeria is the only "120" Group company not concerned with the production of columbite. In recent years its output of tin has been tending to fall. It never fell below 700 tons a year between 1947 and 1950, but since that time it has not exceeded that level. The company's ore reserves have kept remarkably steady. Output rose last year by about 6 per cent, but the lower average price received more than offset the increase. Since, however, the Annual Accounts are drawn up on a basis of shipments and not production, the results for the year cannot be reliably estimated particularly in view of possible benefits to be received as an O.T.C. Moreover, the directors will be obliged to have present conditions in mind when considering the 1957 dividend.

BISICHI TIN

Rising output and falling costs over the years, together with a substantial output of columbite, have given Bisichi Tin a quite impressive record in recent years.

The new conditions prevailing for both tin and columbite, however, will have drastic repercussions on profits. In 1956, for example, columbite was fetching a profit of £1,270 per ton on 299 tons. The end-1956 financial position was on the tight side, following the purchase of the Gombar property, and the payment of cash as part consideration for the acquisition of a majority holding in Naraguta Tin Mines.

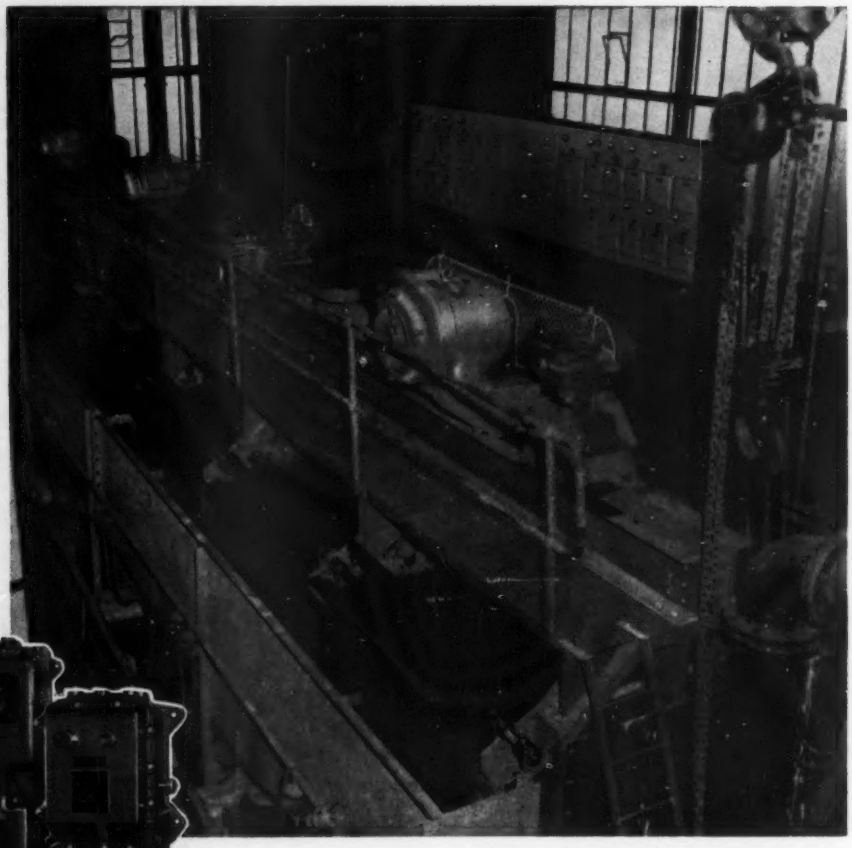
The payment of further instalments to the buffer pool and the possible stockpiling of some concentrates will do nothing to help improve that situation.

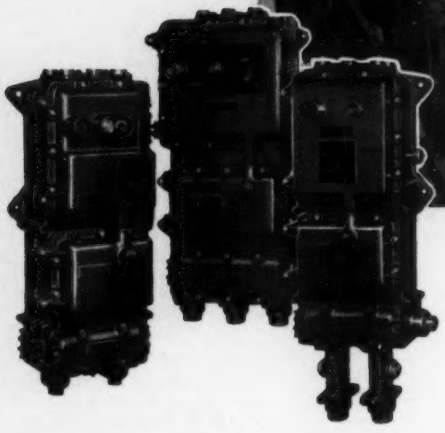
UNITED TIN/RIBON VALLEY

At one time it was proposed to amalgamate the two companies, United Tin and Ribon Valley, but in the end no common basis was found. Ribon Valley, however, continues to hold a one-third interest in the Odegi area, owned by United Tin.

Ribon's output of tin in 1957-58 amounted to 222 tons, the same as in the previous year, but columbite production was only 2½ tons against 20½ tons. United Tin was not able to live up to those standards, its tin output being only 65 tons against 77½, and its columbite 5½ tons against 47¾.

On the surface, or below ground, whatever the application, there is an Allen West starter for every electric motor





Above—Multi-starter switchboard controlling Unifloc separators at the Betteshanger Colliery of the National Coal Board, South-Eastern Division. *Left*—Typical examples from the comprehensive range of standard starters—fully "Buxton" certified.

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Kaduna Syndicate Ltd.

ALTHOUGH tin-ore sales in 1956 by Kaduna Syndicate, amounting to 300 tons were still well below the pre-strike figures of 340 tons in 1954, they showed a useful improvement over the 1955 level. This gave the company a good start and was powerfully reinforced by the price obtained of £527 per ton of tin ore which was the best since 1952 when the Korean boom was still being felt. With this background it is axiomatic that revenue should recover some of the lost ground.

Higher wages and costs generally have edged up costs of recovering a ton of tin-ore since the more normal conditions of 1954, and this has taken away some of the benefit of an enlarged revenue. The tax authorities too have also taken a portion of the expansion, and though revenue was £30,000 larger in 1956 than in, 1955, net profits were only £2,200 higher.

The board decided to pass on this sum to the shareholders, raising the dividend from 41 2/3rd per cent to 50 per cent and retaining about £1,700 out of the year's profits. During 1956, a contribution amounting to £13,843 was made to the international buffer pool, and, because of the apparently long term nature of that contribution, it has been classified among the fixed assets. Most of that contribution appears to have been financed, in effect, by a reduction in investments in British Government securities, and this transfer has reduced the net current assets. The reduction is, however, not serious. At the end of 1956, current assets totalled £123,667, and current liabilities and taxation £66,821, leaving a surplus of £56,846, equal to over 1s. 2d. on each of the issued 960,000 shares, which resulted from the capital repayment of December 1952. This is on the conservative side, since trade investments, valued at over £4,300 and the buffer stock payment of £13,843 have been excluded, though the liability of £5,000 for staff superannuation has also been left out.

On the physical side, the picture is not quite so encouraging. The year's operation took 94 tons out of the recorded reserves and closer prospecting has indicated that the reserves were over-estimated by 45 tons. Thus, the ore reserves at the end of 1956 were down to 413 tons. In addition there are indicated reserves of low grade ground aggregating 271 tons and a possible tribute output of 100 tons.

Production during 1957 was slightly higher at 321 tons, but with tin realizing a lower price during 1957, profits seem likely to be squeezed. Moreover, the board's attitude towards a dividend will be tempered by events in the international tin markets.

The Nigerians have been hit rather worse than other tin producers, and Kaduna Syndicate was given a quota of only 46¼ tons for the first period, which was extended to cover 3½ months. The allocation for the second quarter of the year appears to be in the region of 35 tons, giving the equivalent of 70 tons for the first half of the year. Production in the corresponding period of 1957 amounted to 152½ tons, so that, for the first half of the current year at any rate, the company faces a very harsh cut-back.

One of the unknowns at this stage is the effect which a much smaller output will have on costs. Further unknowns are the reactions of the tin market to the effects of the severe quotas imposed, and eventually the size of the quotas allowed for the second half of the year.

The company has obtained provisional status as an Overseas Trade Corporation as from December 1, 1957. The resulting benefits under the Finance Act should be of material assistance.

Year to Dec. 31	Output (tons)	Sales (tons)	Per ton Ore Price £	Per ton Ore Cost £	Tin Sales £	Ore Reserves (tons)	Year to Dec. 31	Gross Revenue £	Total Expenses* £	Taxation £	Net Profit £	Dividends (Net) %	Dividends (Net) £	Carry Forward £
1956	304	300	553	259	166,030	413	1956	169,180	126,956	26,666	15,558	50	13,800	12,188
1955	242	260	527	277	136,996	552	1955	139,885	106,741	19,780	13,364	41⅔	11,500	9,852
1954	332	340	511	196	173,667	622	1954	176,568	115,065	34,380	27,123	66⅔	18,100	11,729

*After adjusting for opening and closing stock of tin ore.

Kaduna Prospectors Ltd.

FOR some years there have been doubts about the length of time that Kaduna Prospectors can maintain profitable mining operations, but the company has managed to discover sufficient ore during each year to replace the bulk of the reserves taken out. In 1956, 25½ tons out of the total production of 71 tons were recovered from the recorded reserves, the remaining 45½ coming from outside the reserves. As 18 tons were added to the reserves, the net result was a fall over the year of only 7½ tons, reducing them to 99 tons. At this rate Kaduna Prospectors could keep in existence for a long while.

The financial results of 1956 were rather better than those of the preceding year. They came from a number of factors. Although the year's output was raised to 71 tons, against 63½ tons in the previous year, sales dropped from 70 tons to 50 tons. This poor start was compensated to an extent by an improvement in the price received—the third successive year in which better prices were obtained. Incidentally, that series has now ended. The net result of these two conflicting trends was a decline in revenue of about £8,800, but expenses fell to a remarkably low level, some £10,000 below that incurred in the previous year, so that, even after the tax authorities had taken £2,467 as compared with £1,620, net profits rose by £214. This was acknowledged by raising the dividend from the 12½ per cent to 16¾ per cent.

At the end of 1956, current assets which were all liquid amounted to £27,992, and as stocks of tin ore have been included at cost, the realizable value of those assets would be in excess of the sum mentioned. On the other side of the balance sheet, current and deferred liabilities stood at only £5,952, leaving net current assets, on the balance sheet valuation, of £22,040, equal to over 2s. 2d. on each of the 200,000 issued shares of 2s. This calculation ignores the value of the plant and property in Nigeria, and of the trade investments; it also omits the £3,808 contribution at that date to the international buffer pool. Since that date further calls have been made by the pool manager, but it is clear that the company is still well placed financially.

During 1957, the production of tin ore further improved to 86 tons, an expansion of roughly 20 per cent over the previous year. It seems almost certain that during the year costs have risen, and it is well known that the tin price was considerably lower. Last July the chairman expressed the hope that the dividend for 1957 would be at least equal to that for 1956, that is to say 12½ per cent. He made the statement subject to the metal price remaining at a satisfactory level. It has subsequently fallen below the £750 ruling when he spoke but it is probable that if that hope does not materialize, it will be the imposition of quite severe quotas on production rather than the lower metal price which will be responsible.

The quota fixed for the first period was only 11¼ tons, and this signifies that the quota for the second quarter will be about 10 tons. That would bring output for the first half of 1958 to around 20 tons, as compared with 36½ tons in the first half of 1957. This introduces quite a new problem for the company, which would be solved only partially by a sharp rise in the price of tin above the floor of £730.

The company has obtained provisional status as an Overseas Trade Corporation as from December 1, 1957. The resulting benefits under the Finance Act should be of material assistance.

Year to Dec. 31	Output (tons)	Sales (tons)	Per ton Ore Price £	Per ton Ore Cost* £	Tin Sale £	Ore Reserves (tons)	Year to Dec. 31	Gross Revenue £	Total Expenses £	Taxation £	Net Profit £	Dividend Distribution† %	Dividend Distribution† £	Carry Forward £
1956	71	50	564	329	28,176	99	1956	28,788	24,598	2,467	1,723	16¼	1,917	2,761
1955	63½	70	528	365	36,994	106½	1955	37,667	34,538	1,620	1,509	12½	1,438	2,795
1954	70	70	521	313	36,478	112	1954	37,146	30,300	4,123	2,723	25	2,833	3,079

*Computed on f.o.r. basis. †On an issued capital of £20,000.

The International Nickel Company of Canada Ltd.

CANADA has enjoyed a pre-eminent position in the world's nickel industry since 1905. Each year, the percentage of the Free World's nickel which is mined in Canada makes an imposing figure. This situation can be explained by three allied arguments. In the first place, there are large and very valuable nickel-bearing ore deposits in the Dominion and they came to public attention at an early date. Secondly, since the earliest development stages of the nickel industry, Canadian producers have displayed great confidence in the future of the metal and have shown willingness to risk large sums of money on that future. Finally, and this point is perhaps of paramount importance, the Canadian nickel producers recognize their dependence on export markets and have taken and are taking all available steps to create and expand markets for their product.

The International Nickel Company of Canada, Limited, parent company of the Inco-Mond Organization, is the largest producer of nickel in the world and a leading producer of copper and the platinum metals. Although the volume of Inco's products sold within Canada in recent years has been increasing, the Company's export trade is by far the most important of its activities. In a situation where over 90 per cent of all nickel mined in Canada is exported, the importance of International Nickel in the mining and metallurgical industry of the Free World can hardly be over estimated.

For many years the uses of nickel were restricted and nickel alloy steels, nickel silvers, coinage and plating consumed most of the world's nickel. Much time, money and effort have been spent by the Development and Research Division of the Inco-Mond Organization in expanding these fields of interest and in searching for new applications.

HIGH TEMPERATURE FIELD

An important use of nickel today is in the high-temperature field, where service requirements are rigid, particularly in jet aircraft and industrial gas turbine engines and in atomic energy and power equipment. Because nickel imparts generally beneficial effects at high temperatures to the strength, stability and corrosion-resistance of metals, practically all accepted high-temperature alloys incorporate appreciable percentages of nickel. Without such an alloy as nimonic, a high-nickel alloy produced by Mond's subsidiary, Henry Wiggin and Company, Limited, the jet engine could not have become a practical reality. As industry continues to trend to higher temperatures, nickel-containing high-temperature alloys will attain even greater significance.

Less striking to the public eye, but of great importance to industry, are the almost innumerable smaller applications in which nickel plays a part. In these cases the metal is used because it confers a unique property or combination of properties thereby providing almost the ideal material for a specific use. Taken by and large these smaller applications consume large amounts of nickel and, perhaps more importantly, they have often acted as an introduction to other uses in which nickel has a larger application. More than 3,000 alloys containing nickel in varying proportions are currently in use, ranging from 99.7 per cent in malleable nickel down to 0.02 per cent in a hardenable silver alloy.

14 SHAFTS

The principal nickel-bearing region currently worked in Canada is around Sudbury, in Ontario. Within a radius of 30 miles of Sudbury, Inco operates five underground mines. There are 14 operating shafts and some 427 miles of underground workings. The ore is taken by rail to the reduction works at Copper Cliff and the smelter at Coniston. At Cooper Cliff, grinding, flotation and smelting operations eliminate stony and earthy materials, iron and sulphur and separate the copper from the nickel. The final products are blister copper, nickel oxide sinter and sintered matte.

All the copper concentrates from the Company's ores are now treated by flash smelting with oxygen instead of using pulverized coal. A special type of smelting furnace and a plant to produce oxygen were built in 1951. The blister copper is refined electrolytically to a purity of 99.97 per cent plus and the refinery produces 55 different types of commercial copper cast shapes as well as cathodes. Inco produces approximately half of Canada's total copper output and its copper is sold principally in Canada, with the United Kingdom as the second largest market.

Nickel-oxide sinter goes direct to customers, sintered matte is shipped to the refinery at Port Colborne, Ontario, and the Mond Nickel Company refinery at Clydach, South Wales. At Port Colborne, the nickel is refined electrolytically into cathodes. Electrolytic cobalt has been produced at Port Colborne since 1954, and from the sludge removed from the electrolytic tanks, the Company produces gold, silver and five platinum metals. Selenium and tellurium are also recovered and refined.

The 14th mineral element obtained from the Sudbury ores is high grade iron ore; higher in grade than any other produced in quantity in North America. First unit of the iron ore recovery plant, an investment of $19,000,000, was brought into commercial production early in 1956 and shipments during that year amounted to 71,000 l.tons. When operating at full capacity, this unit will treat 1,000 tons a day of pyrrhotite recovered from the ores during the early treatment stages. This corresponds to an output of 250,000 tons of iron ore per year and when planned additions have been completed and brought into production it is expected that ultimate production of iron ore will be triple that of the first unit. The year-end figures for 1957 show that in that year the Company delivered 113,000 l.tons of iron ore.

Inco's United Kingdom affiliate, the Mond Nickel Company, Limited, operates a refinery at Clydach, near Swansea, which receives sintered matt from Copper Cliff and produces pellet nickel by the Mond Carbonyl Process. In addition, the refinery at Clydach produces nickel salts, cobalt salts, copper sulphate and iron powder. A Mond refinery at Acton, London, produces platinum metals, gold and silver from concentrates semi-refined in Canada and from residues recovered after the refining process at Clydach.

A ten-year search in Northern Manitoba for new sources of nickel reached a climax in December 1956 with the announcement that Inco would develop a new nickel mining centre in the Mystery-Moak Lake region of that province. Throughout 1957 a force of up to 1,000 men was engaged in developing the project into the world's largest source of nickel supply. It was possible to work, even so far north, throughout the year because of the availability of 30,000 tons of material and supplies brought into the area by tractor train during the early winter months of last year. Favourable progress at the Thompson mine, named after Inco's Chairman, brought about the decision to bring this property into production first. The project's scheduled output of 75,000,000 pounds of nickel a year will come initially from the Thompson mine. In October 1957 the railroad link joining the Company's property with the Canadian National Railways' Hudson Bay Line was completed.

That is a brief picture of the activities of the Inco-Mond Organization as a mining company. It is a story of international activity and organization but it does not stress one of the most important aspects of the Company's work. The Inco-Mond Group, in addition to being metal producers are very attentive to the work of development and research. Millions of pounds and dollars have been invested in finding new uses for Company products and almost every industry has benefited. In many instances the application was vital though the potential tonnage was small.

Development and research was conducted on a very small scale in the years immediately following the foundation of the International Nickel Co. of Canada, Ltd., in 1902. Inco's first research laboratory was built at Bayonne, New Jersey, in 1906. It was with the end of the First World War and the need to establish new uses for nickel in civilian industry that development activities became of major importance, and in 1922 a Development and Research Division was organized in New York.

A "PLUS" VALUE

To the user of Inco-Mond nickel, in its pure form or as an alloying element, there is a "plus" value added to the metal because of the knowledge and experience of the scientific and technical staffs at the service of the customer. Inco has developed applications on the basis that a continuing and increasing market must have a sound foundation and that in building this foundation the supplier must work closely with the user to ensure that when nickel is chosen for a job, the choice is a proper one and the metal is used wisely. Thus, both the supplier and the user share in the benefits that come with the proper use of the metal.

To put this policy into practice, the Company has a world wide organization of information centres which provides a means whereby technical information on

uses and answers to customers' problems are offered to industry. It is this kind of service which gives Inco-Mond nickel a "plus" or bonus quality.

Nickel has been brought into the public eye in recent months by the change in the supply-demand situation. The year 1957 marked a turning point in the career of nickel in industry. Towards the end of last year, the supply of nickel, after meeting defence requirements, exceeded civilian demand for the first time since the Korean War began in 1950. As a consequence of these developments and in view of the fact that increased supplies are anticipated, the use of nickel by civilian industry can once again be governed exclusively by technical and economic considerations. During the last few months of 1957, the Company put into effect previously developed plans to sell its nickel under conditions of abundant supply-plans including intensified sales and research and promotion activities designed to develop larger markets for nickel and its alloys.

By the end of this year, Free World production capacity of nickel is expected to be larger than it was in 1957 and the United States Government has announced its intention to release to industry all of the nickel under contract for delivery in 1958 to the Government stockpile. In the first months of this year, stocks of nickel were accumulating in the hands of producers.

MARKET RESEARCH

To meet the changed situation, a programme has been launched to have the use of nickel restored in application where other materials were substituted during the period of inadequate supply, and also to increase the nickel content of alloys which had been downgraded. Market research has been expanded and co-operation with the market research organizations of Company's customers further developed.

Expenditures for development and research have been increased, and emphasis placed on research projects promising increase in the use of nickel. Prominent among these are new nickel steels offering economy and special properties for gears, heavy forgings and services at sub-zero temperatures, and high nickel alloys for automotive gas turbines and for atomic power plants. As a supplement to work in its own laboratories, the Company continued to sponsor research in university and industrial research laboratories to broaden the scientific basis for new nickel markets.

EXPLORATION

Apart from the work of research and development of markets, the Inco-Mond Organization has been very active in the work of development and modernization of its own production facilities and in exploration for new nickel deposits. In the Sudbury District, systematic investigation of the extensions of ore zones and favourable structures has been undertaken, both from the surface and underground, with satisfactory results. Tests of the ore possibilities were continued in the area which includes Inco's Coppermine River Concession in the Northwestern Territories, in Canada. In 1957, substantial exploratory programmes were also conducted in Saskatchewan, Quebec and Australia and property examinations were made in Africa, the East Indies, the West Indies and elsewhere.

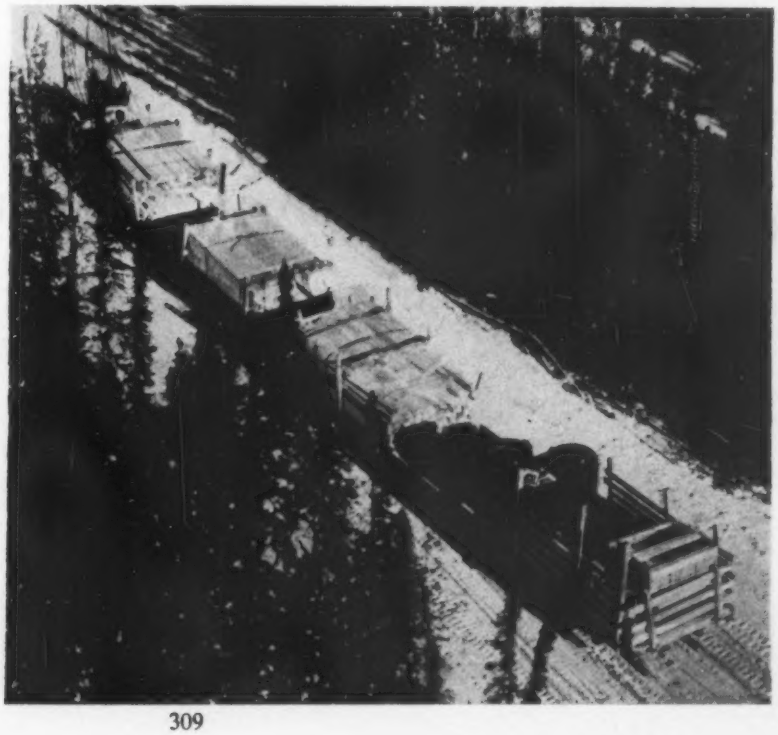
At the Port Colborne refinery, a new process has been developed for the recovery of nickel by the direct electrolysis of nickel matte. This process also permits the recovery of cobalt and, for the first time, of high purity elemental sulphur and selenium. A section of the existing electrolytic units of the refinery has been modified to accommodate the new process and a fractionating column of special design has been installed for sulphur-selenium separation. This marks another of the important advances in chemical metallurgy made by the Company. New decomposers have been installed at the Mond refinery at Clydach and the "modernization and concentration" plan, whereby the activities of Henry Wiggin & Co. Ltd., are concentrated in the new plant at Hereford is continuing.

The reversal of the supply-demand situation is a result primarily of increased production, reduction of defence and stockpiling requirements and the slackening of general industrial activity in America. For this last reason, International Nickel with a finger on the pulse of American industry announced a cut-back in production in March of this year. At the time a Company spokesman said that "unless business in Canada and the United States shows a quick upturn a further cut back in our production may become necessary." Such a situation has arisen and a second cut was made in April. Under the circumstances these cuts are undoubtedly examples of the close liaison between Inco and North American industry and the Company can return to maximum production as soon as the market warrants such a move. The cuts have no relation to the markets in Europe and outside the Americas which are served by the Mond Nickel Company. In all areas, civilian industry, accustomed for eight years to think in terms of inadequate supplies of nickel, has not had sufficient time to adjust itself to conditions of plentiful supply.

LONG TERM OUTLOOK

In the Annual Report for 1957, Dr. John F. Thompson, Chairman, and Mr. Henry S. Wingate, President of Inco, closed their review by saying:—

"The long-term outlook for nickel is excellent. During the years of shortage for civilian purposes, nickel has demonstrated that its many properties fit into the pattern of modern technology. This strengthens our conviction that nickel will have an even greater economic value than in the past, and that there will be a long future of upward trend in nickel consumption. Our faith in the future of nickel is clearly demonstrated by the determination with which we are proceeding in the development of our great new source of nickel supply in Manitoba, which will come into production in 1960 as scheduled. Hand in hand with this project, all of the years of experience of the Company in market development are being called upon to accelerate the uses of nickel over a wide base of applications in all parts of the world."



A "Snowball Express" tractor freight train, operating on Inco's Mystery—Moak Lakes project.

Rio Tinto Group

THE Rio Tinto Co. Ltd. was incorporated in England in 1873 to acquire the Rio Tinto mines near Seville which had been producing copper on a small scale intermittently since Roman times. Under the Company's management the mines became one of the largest copper producers in Europe and also its most important source of pyrites.

In 1928 a decision was taken to widen the Company's interest. The evergrowing demand for copper influenced the Company in taking considerable interest in the Rhodesian Copperbelt, which in turn led to important investments being made in that area.

By 1954 it was decided to make a further change and arrangements were made to sell two-thirds of the interests in the Spanish mines to a newly formed Spanish company—the Compania Espanola de Minas de Rio Tinto, S.A. The Rio Tinto Co. however retains a one-third interest in the Mines and also acts as the Spanish Company's selling and purchasing agent outside Spain as well as providing technical and consultative services.

In 1955 the Rio Tinto Group seized opportunities which arose to participate in the development of the imporant deposits of uranium in the Blind River area in Ontario and at Mary Kathleen in Queensland. These developments provided an admirable opportunity for a new investment; they were also in line with the Company's policy of development as a Commonwealth mining house. This decesion was undoubtedly the most important single factor that has brought about the expansion of the Rio Tinto Co. into a Group of Companies which are currently under contracts amounting to over £250,000,000 to produce uranium oxide for the U.K. and Canadian Governments.

In 1957 in order to broaden and balance the interests of the Group in basic fuel materials, it was decided to extend its activities to oil in the New World.

In May 1958 the U.S. and Canadian Governments announced that producers of uranium oxide might sell surplus production in the open market subject to the existence of bilateral agreements between the countries concerned. In his annual statement to shareholders the chairman, Mr. G. E. Coke, pointed out that the Rio Tinto group would shortly have sufficient plant capacity to meet outside demands.

CANADA

The Company holds slightly over 50 per cent of the share capital of the Rio Tinto Mining Co. of Canada Ltd.

During the present period of depressed base metal prices the fixed price government contracts for uranium oxide held by the four companies managed and controlled by the group in Canada and in which the Company has a substantial profit interest (Pronto Uranium Mines Ltd. 14 per cent; Algom Uranium Mines Ltd. 38 per cent; Northspan Uranium Mines Ltd. 33 per cent) are considered particularly valuable. These contracts, which total $630,000,000, are due to expire between 1961 and 1963 by which time it is calculated that the loan capital will have been repaid and reasonable profits will have become available for dividend payments.

Pronto and Algom are in full production and the following is a summary of their operating results for 1957:

	Pronto	*Algom*
Tons milled, year	507,122	1,990,382
,, ,, per day	1,389	5,914
Grade lbs. U_3O_8 per ton	2.55	2.32
Gross revenue	$11,022,000	$44,362,000
Net operating profit before depreciation or pre-production write-offs	$4,533,000	$18,267,000
Outstanding debt (at year end)	$4,524,000	$38,900,000
Net current assets (at year end)	$1,538,000	$2,886,000
Initial Government contract	$55,000,000	$206,910,000

The milling capacity of Pronto was increased in May 1957 from 1,200 tons per day to the forecast rate of 1,500 tons per day, while at Algom the planned milling rate of 3,000 tons per day at each of the two mines was attained about the middle of that year.

The construction of the three Northspan mills proceeded during the year and at Lake Nordic the first circuit began producing uranium oxide in November, 1957, and reached its planned rate in December 1957. The second unit of smaller capacity was completed in January, 1958, and in March also reached full production.

The Panel mill with a capacity of 3,000 tons per day was run in during January, 1958, and is expected to be in full production in June.

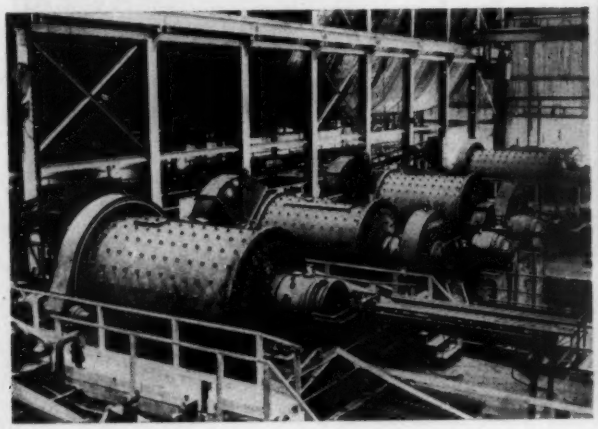
The Spanish American mill with a capacity of 2,000 tons per day has been completed, but underground development has been somewhat delayed by water troubles. The mill is expected to be working at full capacity by August, 1958.

Construction at Milliken Lake has been proceeding according to plan; the mill was run in during April, 1958, and is likely to reach its capacity of 3,000 tons per day during July.

At Elliott Lake, in the centre of the Blind River field, a new town for 18,000 people has been established under the auspices of the Canadian Government to house workers from all the various companies mining in this area; the Rio Tinto Group has been directly or indirectly responsible for arranging building contracts and finance for half the number of houses built or under construction.

As a result of a share exchange in October, 1957, The Rio Tinto Mining Co. of Canada acquired 51 per cent of the share capital of Preston East Dome Mines Ltd., which in turn holds 75 per cent of that of Algom. Preston is a gold mining company operating in Ontario. During 1957, 68,376oz. of gold were produced from 254,000 tons milled and the net operating profit before depreciation was $197,000.

Below left, a section of the Algom Quirke ball mill. Below right, sampling the classifier overflow in the Algom Quirke ball mill



The Mary Kathleen uranium mine, Queensland.

Early in 1958, The Rio Tinto Mining Co. of Canada Ltd. and Dow Chemical of Canada Ltd. jointly formed a new company, Rio Tinto-Dow, with the initial object of producing thorium and rare earths from the by-product materials of Algom, Northspan and Milliken Lake, which are also shareholders in the new company.

Production of a high purity thorium compound is expected to start later in 1958 and the capacity of the plant will be expanded as the nuclear and industrial demand for thorium increases. The potential production from these mines is many times the world's present requirements.

Research will also be undertaken into methods of producing a reactor grade uranium compound.

Exploration teams of Rio Canadian Exploration Ltd. are currently prospecting in British Columbia, Saskatchewan, Ontario, Quebec and New Brunswick.

AUSTRALIA

In 1955 through its subsidiary The Rio Tinto Mining Co. of Australia Pty. Ltd., the Company acquired a majority interest in Mary Kathleen Uranium Ltd. (M.K.U.) and is responsible for its management. This uranium deposit is the most important yet found in Australia.

The capital cost of construction exclusive of interest will be in the region of £A9,000,000 of which 80 per cent has been provided by the United Kingdom Atomic Energy Authority (U.K.A.E.A.), and the remainder by the Rio Tinto Group. Ore is at present being mined and stockpiled to await completion of the Treatment Plant which is due to be operating by mid-1958. In 1956 the U.K.A.E.A. contracted with M.K.U. to purchase uranium oxide to be gross value of between £A40,000,000 and £A45,000,000,000. It is planned to complete this contract in eight or nine years. A recent re-calculation of ore reserves has shown that they will be in excess of that required to complete the initial contract with the U.K.A.E.A.

Owing to the remoteness of Mary Kathleen it has been necessary to construct a complete new town for 1,000 people with all the amenities and facilities which must be provided today if a reasonably comfortable life is to be enjoyed in the outback of tropical Queensland.

An extensive programme of general exploration for minerals is being conducted by Rio Tinto Australian Exploration Pty. Ltd.

In Queensland, in association with Le Nickel S.A. and Siamese Tin Syndicate Ltd., airborne geophysical surveys have been completed. The programme for 1958 is the follow up of the anomalies which have been disclosed by the airborne surveys.

In Tasmania, the exploration of the north-west part of the island will be continued in association with the Electrolytic Zinc Co. of Australasia Ltd.

AFRICA

The Company's extensive investments in certain of the Northern Rhodesian copper mining companies are for the moment its main source of income until such time as the uranium mines in Canada and Australia have repaid their capital costs.

In 1957 exploration by Rio Tinto Mineral Search of Africa (Private) Ltd. in Northern Rhodesia established the existence of the Lower Roan series in certain areas over which Rio Tinto (Northern Rhodesia) has exclusive prospecting rights, but so far no mineralization of economic interest has been proved.

In Southern Rhodesia a prospect shaft was sunk and a pilot plant set up at a copper-nickel deposit at Empress Nickel near Gatooma. It has been decided to place this on a care and maintenance basis pending an improvement in general conditions. Estimates of capital and operating costs, together with all outline design work have been completed.

In the Union of South Africa the Group is responsible for the management of The Palabora Mining Co. Ltd. which is currently examining a low grade copper deposit in the north-east Transvaal. Drilling of this deposit has started and will be continued throughout 1958 into 1959. The results to date are encouraging but they must be viewed in the light of the prevailing low price of copper. The Newmont Mining Corporation and Transvaal Ore Co. Ltd. are associated with the Group in this project.

UNITED STATES OF AMERICA

At Wilmington, Delaware, a subsidiary The Pyrites Co. Inc. produces iron ore sinter from various iron bearing materials which are available locally. It operates a cobalt extraction plant which treats cobalt bearing pyrites cinders. During 1957 market conditions for both cobalt and sinter became increasingly difficult.

OIL INTERESTS

Kern Oil Co. Ltd.

In May 1957 Rio Tinto also took over the Kern Oil Co., Ltd., with properties both in the United States of America and also in Trinidad. The U.S.A. properties are situated mainly in South and Central California, and in 1957 produced just over 1,250,000 bbl. gross.

A wholly owned subsidiary, the St. Helens Corporation holds exploration acreage mainly in the states of Wyoming, Utah, Montana and Colorado.

Kern Trinidad Oilfields Ltd. a subsidiary operating in Trinidad, owns approximately 2,600 acres which is currently producing oil, and in 1957 production exceeded 1,000,000 bbl. gross. It also has off-shore rights in the Gulf of Paria.

Devon-Palmer Oils Ltd.

During 1957 Rio Tinto bought a 25 per cent interest in Devon-Palmer, a Canadian company currently producing 2,500 to 2,600 bbl. of oil a day from its wells principally in Alberta and Saskatchewan. Devon-Palmer also has interests in gas wells on the British Columbia-Alberta border, and is interested in a sulphur extraction plant being planned south-east of Calgary. Oil reserves are estimated to be in excess of 10,000,000 bbl., gas over 122,000,000,000 cu. ft. and sulphur over 2,000,000 tons. Production during 1957 was over 700,000 bbl. of oil.

RIO TINTO GROUP RESULTS (Excluding special items)

Year	*Ordinary Shares in Issue*	*Profit and Loss Results* *Group* £(000)	*Parent* £(000)	*Group Capital Expenditure (Net)* £(000)	*Rate of Dividend*
1954	2,125,000	658	644	2,386	30% F.O.T.
1955	4,250,000	1,009	1,087	3,686	15% F.O.T.
1956	5,100,000	1,474	1,470	5,392	15% F.O.T.
1957	7,298,200	1,491	1,306	8,082	26% Gross

NOTES:

(1) The proportion of profits of The Rio Tinto Mining Co. of Canada Ltd., attributable to The Rio Tinto Co. Ltd., has been excluded.

(2) The assets of The Rio Tinto Mining Co. of Canada Ltd. have been excluded and the investment in that Company by The Rio Tinto Co. Ltd. included.

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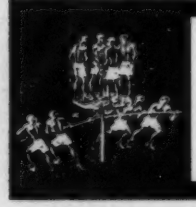

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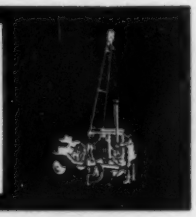

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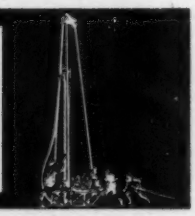

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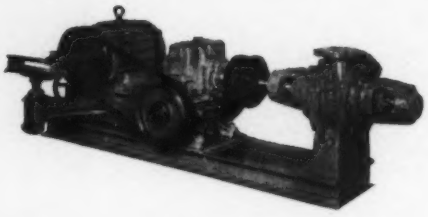

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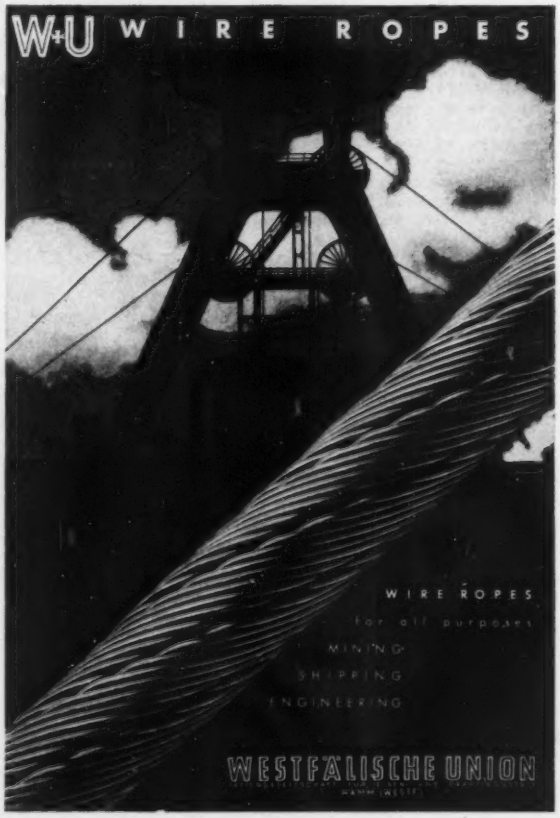

Mount Isa Mines Ltd.

OF the many and varied factors to be taken into consideration when assessing the position and prospects of Mount Isa Mines, the big Australian copper-lead-zinc-silver producer, the most enduring is the company's geographical isolation.

Situated in the tropical zone in north-west Queensland, Mount Isa is the only sizeable town between Townsville on the Pacific coast and Darwin, a distance of approximately 1,200 miles. This means there is no seaport nearer than Townsville and that the main land link between it and Mount Isa is over a light single track railway. Machinery, equipment, raw materials and foodstuffs all have to be borne inland by rail, while bullion, dross, zinc concentrates and blister copper all have to be carried by the same rail link for shipment or disposal. In particular, the availability of coal, of which some 2,300 tons are required each week by the mine, has at times become of critical importance.

Year to June 30	*Ore Milled (tons)*	*Silver (ozs.)*	*Lead (tons)*	*Copper (in dross)*	*Zinc (tons)*	*Copper (blister)*
1957	1,404,813	3,887,851	45,190	898	18,386	28,875
1956	1,382,476	3,289,645	36,545	—	15,648	24,408
1955	1,244,192	3,370,920	39,730	893	17,701	21,585
1954	1,210,980	3,090,936	37,926	682	20,513	19,869

It is against this background of inadequate transport facilities that the company's scheme to expand production from 4,000 tons of ore a day to 13,000 tons a day must be viewed. The event which made practical the expansion on such a large scale was the discovery in 1951 of a large new copper formation, since designated the 500 orebody.

The expansion programme commenced in 1956. Plans included the construction of a £3,500,000 copper refinery at Stuart, near Townsville, which will have an initial annual capacity of 30,000 tons of blister copper and is designed for rapid expansion to deal with 60,000 tons a year; the conversion of the company's present mill solely to treat copper; the building of a large new lead-zinc mill; large scale extensions to the main haulage shaft; a new dam to store 17,000 million gallons of water; and a second power station with an initial capacity of 30 megawatts.

Although the construction of the new lead-zinc mill has been deferred pending railway improvements, considerable progress has already been made with the expansion programme. The dam on the Leichhardt River has been completed together with the pipe-lines and pumping stations. The new 4,500 h.p. hoist on the No. 2 ore shaft was commissioned at the beginning of this year and additional grinding and flotation units have been installed in the mill. Moreover, construction is well under way with the new 30 m.w. coal burning power station which should be in operation in early 1960. The new Assay and Research Laboratory has been finished and the new Administration Offices were occupied earlier this year.

The programme was planned in two stages. The first envisaged raising mine production from 4,000 tons of sulphide ore per day to 7,000 tons per day, to be completed by December, 1959. The second stage involves production increase from 7,000 tons per day to 13,000 tons per day, to be completed by 1963. Completion of the second stage is dependent on the Government improving the Mount Isa-Townsville rail link.

How far and to what extent the Queensland and the Federal Governments will improve the rail link is not yet known, but on the assumption that some rehabilitation will be proceeded with and on the fact that the recent introduction of small diesel locomotives on the line has substantially improved the transport system, Mount Isa is proceeding with its expansion plans to an intermediate stage. The intermediate expansion programme, which has for its target the production of 7,000 tons of sulphide ore a day, incorporates many of the works common to the programme of expanding to 13,000 tons a day. In fact, 60 per cent of the cost of the final programme is covered by the intermediate programme.

The first stage of the intermediate programme was completed in October, 1957. At present a production rate of 5,500 tons per day has been attained and this will be steadily increased to 7,000 tons a day which it is expected to reach in December, 1959. Before that, however, in June, 1959, the electrolytic copper refinery at Stuart, near Townsville, will be in operation.

This bold and imaginative expansion programme will not cause the company any worries with regard to the availability of ore. At the end of June, 1957 copper ore reserves totalled 12,800,000 tons of 3.75 per cent copper, an increase of 5,000,000 tons over the previous year. This is the result of vigorous exploration and development with much of the increased tonnage comming from the 500 orebody. Diamond drilling has indicated considerable tonnages of ore not included in the reserves. Incidentally, Mount Isa's copper resources are somewhat unique in that there is no association between its lead and copper deposits. Silver-lead-zinc ore reserves can, therefore, be calculated separately and these at the end of June, 1957 totalled 20,700,000 tons of 5.8 oz. silver, 7.9 per cent lead, and 6 per cent zinc which represents an increase of 6,500,000 tons of 5.3 oz. silver, 7.5 per cent lead and 5.8 per cent zinc over last year's reserves.

The keynote of Mount Isa's career has been one of development largely financed from earnings, but the recent fall in metal prices—greater than most recognized authorities had predicted—has reduced the estimated funds available to finance the present expansion programme. Accordingly, arrangements have been made to raise privately £1,500,000 Debentures for Copper Refineries Pty Ltd., which is constructing the electrolytic copper refinery at Stuart, near Townsville. Financial accommodation has been arranged with the Bank of New South Wales Savings Bank Ltd. to take over the financing of the Co-operative Building Societies. Other arrangements have been made to secure short term loans to finance the company's metal in the pipeline which, at June 30, 1957, were valued at £6,545,590. This latter arrangement should also provide sufficient funds to complete the expansion of production to 7,000 tons a day.

Mount Isa has also given consideration to simplifying its capital structure with particular reference to the Mining Trust Ltd., a wholly owned subsidiary owning all the issued capital of Britannia Lead Co. which owns the lead refinery at Northfleet in the U.K. which refines all Mount Isa lead bullion. The Mining Trust at June 30, 1957, held £861,637 of the £869,593 outstanding 8 per cent Mount Isa Mines Ltd. Debentures which were redeemed in November, 1957. The Mining Trust also holds all the issued capital of Copper Refineries Pty Ltd., which is constructing the copper refinery at Stuart near Townsville.

At a suitable time, therefore, Mount Isa plans to liquidate the Mining Trust, in which case the issued shares in Britannia Lead and in Copper Refineries and other assets will pass automatically to Mount Isa Mines.

The company's future remains bound up with the provision of adequate rail facilities and, of course, the future trend of prices for the metals it produces. The present depressed price levels for copper, lead and zinc will, as Mr. G. R. Fisher pointed out in his statement from the Chair to stockholders last December, have a marked effect on the company's earning capacity but that the impact will be reduced by various factors. Certainly, the planned increase in production will reduce costs while the shock-absorbing qualities of the lead bonus scheme, which provides for the payment of 6d. per shift on every £1 rise above £57 per ton, ought to be a helpful factor. There is, too, the fact that the Australian copper price is held at the producers' figure which is higher than the world price for the metal.

On the other hand, the present state of base metal prices militates against the pursuance of an active exploration programme which was followed vigorously last year by the company itself and jointly with Zinc Corporation. Exploration on its own account in 1955 uncovered a promising lead deposit at the Reward claim about 40 miles south-west of Borroloola in the Northern Territory. Two shafts have been sunk and crosscuts from the 60 ft. level disclosed an average width of 98 ft. of ore containing about 9 per cent lead. Exploration of this deposit is continuing.

Year to June 30	*Metal Sales** (£A000)	*Mining Costs* (£A000)	*Lead Bonus* (£A000)	*Taxation†* (£A000)	*Net Profit* (£A000)	*Dividend‡* (£A000)
1957	17,199	—	—	800	3,140	863
1956	17,296	8,377	1,941	993	4,301	1,439
1955	13,782	7,066	1,422	941	3,307	1,439
1954	10,548	5,838	1,034	520	2,096	1,151

**Less transport, refining and realization expenses*

†Excluding provision of £1,100,000 for income tax equalization.

‡Excluding payment of 6d per 5s stock unit satisfied by a one-for-ten scrip issue.

Tronoh-Malayan Tin Group

Malaya Encourages the Foreign Investor

THE year 1957 drew attention to three outstanding dates affecting Malaya. On April 9, 1957, the Chancellor of the Exchequer, in his Budget speech in the House of Commons, introduced a new type of taxation concept—Overseas Trade Corporations. On August 31, 1957, the Federation of Malaya became a free and independent sovereign member of the Commonwealth. And on December 15, 1957, the International Tin Council imposed export controls on tin.

The tranference of power to Malaya ending eighty years of British Administration was bound to raise some doubts as to whether the country could absorb the heady wine of independence without running into economic nationalism. But these fears have up to now proved groundless. The Government made plain from the outset that one of its endeavours would be to attract capital from overseas for the development of its industries by private enterprise. Moreover the development of the country's mining industry was accorded first priority in the Five Year Development Plan. Words have been matched by deeds and the security position was improved substantially last year by the Government's continuous war against Communist terrorists who are now reduced to a hard core. Indeed, the intensive nature of military actions now proceeding gives reason to believe that the intentions of Tunku Abdul Rahman, the Prime Minister, to rid the country of the last remaining terrorists before the first anniversary of Independence Day will be realized. If this should be achieved, the removal of all emergency restrictions would open up extensive jungle areas for prospecting.

The acceptance by the U.K. Treasury of Overseas Trade Corporations in the 1957 Budget meant that, in general terms, those companies controlled from the United Kingdom and developing mineral resources and trade overseas receive some measure of tax relief. The U.K. companies in the Tronoh-Malayan group would be eligible to qualify as Overseas Trade Corporations. Accordingly, tax liabilities in the future can be computed in general as follows:

(1) Income tax and profits tax on investment income.

(2) Malayan income tax on the whole profits overseas.

(3) U.K. income tax on gross distribution at a rate equal to the excess of the U.K. rate of tax over the Malayan rate of tax.

For one year, the transitional period, results in tax liabilities on an abnormally reduced scale, and in the following years the savings are still likely to be appreciable.

Since Malaya is the world's largest producer of tin, the deliberations of the International Tin Council and the decision to impose export controls on tin with effect from December 15, 1957, are of great significance to her economy. Under the terms of the scheme, Malaya's share of the world's exports of 27,000 tons, permitted during the first quota period extending from December 15, 1957, to March 13, 1958, was 37.5 per cent or 10,125 tons of tin metal. The overall cut-back in production required was, therefore, severe but each mine was affected differently as individual company quotas were based on their respective production during the five year period, 1953-1957. For this reason each company's position under the scheme is dealt with individually in the following notes.

As a postscript, however, it is germane to point out that the Tin Research Institute has been praised publicly for its recent successes in the use of organo-tin compounds as pesticides and fungicides and it is hoped that, eventually, these will absorb a considerable tonnage of tin.

MALAYAN TIN DREDGING LTD.

The output of tin ore by Malayan Tin Dredging dropped during the year to June 30, 1957: production in the previous year was, however, exceptionally high, owing to one of the four dredges working high-grade ground—it yielded 1.87 lb. per cu. yd. against an average of 0.82 lb. for all four dredges — the reduction was an expected reaction after the dredge had moved out of the limited area, bringing the average yield for the four dredges down to 0.55 lb. per cu. yd. Even so, the output of 2,130 tons was the second best during the past nine years.

The company owns two areas, each with two dredges: at Batu Gajah, and at Kampong Gajah, but the life of the former area is limited. The Kampong Gajah section has an estimated life of 35 years, after a third dredge, which is being erected, has come into operation. At one time, it had been hoped to install a fourth dredge on the Kampong Gajah section, but that project will undoubtedly be shelved until the outlook is clearer, and the incurring of heavy capital spending justified.

For the first quota period, Malayan Tin had sales of 377 tons, which compares with an actual output of 619¼ tons in the December 1957, quarter, and a quarterly average of 532 tons for 1956-57.

SOUTHERN MALAYAN TIN DREDGING LTD.

The company has six dredges, of which one is on the Teja section, and five are on the Tanjong Tualing section. It is planned to transfer one of these to a new property at Degong Road, but these arrangements have not been finalized. One thing is clear, the transfer will involve the expenditure of a considerable capital sum.

The remaining life of the main areas owned by the company has been estimated at 13 years. The deposits on the Degong Road property are expected to be extensive enough to last one dredge for 32 years, but until plans have been completed concerning the equipment of the area, such an estimate is subject to revision.

In addition to the output from the dredges, tin concentrates and ilmenite are being recovered from the amang dumps on the Temoh section.

The company's sales of 586 tons for the first quota period of three and a half months compared with an output of 1,113 tons for the last quarter of 1957. The quarterly average for 1956-57 was only 555 tons.

TRONOH MINES LTD.

The company is recovering tin both in Malaya and, through its subsidiary company, Tin Lay Ltd., in Siam, but the bulk of the tin produced and of the profits earned come from the four dredges operating in the Federation. The dredge with the largest capacity is at Tronoh, the remaining three are on the Kampar section.

The Tronoh dredge has now been converted from oil-fired steam boilers to electric drive. The life of the section will be lengthened as a result, since most of the section's high grade ground has now been worked out and the average grade of ground remaining is lower than the average of recent years.

Satisfactory working is reported from the Kampar dredges; during 1956, one of them, the No. 4, encountered a rich concentration which led to a record recovery for that dredge. Although the amounts won by tributors were small as compared with those produced by the dredges, they yielded a tribute of £29,572 in 1956.

A grab dredge owned by Aokam Tin, financed by the Tronoh-Malayan Tin group, is recovering tin ore from the sea bed off the coast of Siam. Tronoh Mines owns all the capital of Tin Lay Ltd., operating in Siam; the whole of the proceeds from the sale of tin ore in Siam has to be surrendered to the authorities there. And there are delays in getting profits remitted out of the country.

Tronoh's output for 1957 amounted to 2,755 tons against 2,631 tons. The 1958 output will be cut below that level by the

tin restriction scheme: the company's sales for the first three and a half months quota period were 436 tons as compared with an output of 677 tons in the December 1957 quarter.

SOUTHERN TRONOH TIN DREDGING LTD.

Most of the tin ore produced by Southern Tronoh Tin Dredging in recent years has come from the No. 1 dredge. It is, however, nearing the end of the economic life of its present areas, and negotiations are being carried on for leases over two rubber estates in the Sunkai area. Prospecting has proved the existence of 16,000,000 cu. yds. with an average content of 0.56 lb. per cu. yd. This would be sufficient ground for one dredge for about seven or eight years. The authorities responsible for the issue of the leases have delayed the matter for a long time. After the leases are granted, at least one dredge will be moved; the cost of this operation and of acquiring and developing the estate has been estimated at £150,000.

The ground being worked by No. 2 dredge has appreciable quantities of clay, which hampers the task of extracting the values. Special methods of treatment have now been evolved, and the threat of early closure has been avoided. These methods limit the yardage which the dredge can treat, resulting in reduced output and profits, though this is better than the alternative of closing the dredge down.

Under the tin restriction scheme, Southern Tronoh had sales of 138 tons for the first quota period, against actual production of 102¼ tons in the last quarter of 1957. The quarterly average for 1957 was 182 tons.

AYER HITAM TIN DREDGING

Early in 1959, Ayer Hitam expects to have a second dredge, brought over from Australia, in operation, but even then it has sufficient high-grade ground available to last for seventeen years. The cost of purchasing, transferring and erecting the No. 2 dredge will be in the region of £900,000.

Events in the year to June, 30, 1957, proved the wisdom of getting another dredge, for during that period it became necessary to shut the existing dredge down for repairs to the ladder and to carry out other maintenance work. This led to a reduction in the yardage treated and in the amount of tin produced. Another factor responsible for the output of tin ore falling from the comparatively low level of 713 tons in 1955-56, to 488 tons in 1956-57, was the low grade of the ground being worked by the dredge. During the current year the dredge is expected to turn towards the east and to encounter better ground as it advances.

When the second dredge is operating satisfactorily, the present No. 1 dredge will be converted to electric drive, but this is well in the future. Of more immediate concern is the restriction scheme: Ayer Hitam's sales for the first three and a half months quota period were 188 tons. This is above the average for 1956-57 and 1955-56, but much under the level of the preceding years.

SUNGEI BESI MINES LTD.

The two sections owned by Sungei Besi yielded in the year to March 31, 1956, roughly equal quantities of tin ore. The Sungei Besi section uses open-cast methods and the Pelepah section operates a dredge. Of the two methods the dredge recovers tin at a cheaper rate. In order to reduce costs on the open-cast workings a conveyor belt has been installed to replace trucking. This substitution has been so successful that it has been decided to incur the necessary capital expense of bringing in two more belts and eliminating all trucking. One of the effects of using conveyor belts will be to raise the capacity of the section, though this will now have less immediate appeal than when the decision was made some months ago. In order to reach payable deposits on the western side of the leases and to make the task of reaching rich ore below the floor of the present North Open-cast, a road and railway are being diverted. This involves an outlay of about £100,000, but the final results of having more tin ore available and reducing costs are thought to be worthwhile.

Security conditions around the dredge in Johore are difficult. The section being worked by the dredge has an estimated life of seven years.

SUNGEI WAY DREDGING LTD.

This company is incorporated in the Federation, whereas the remaining companies of the group are registered in the United Kingdom. It owns three dredges, all of which were active during the year to June 30, 1957. The ownership of these dredges will enable the board to follow a more flexible production policy during the restriction periods than would otherwise have been feasible. Its sales for the first restriction period were 266 tons, as compared with an output of 423 tons in the December 1957 quarter, and a quarterly average of 354 tons in 1956-57.

The accounts of this company are naturally presented to shareholders in Malayan dollars; in compiling our table below, we have converted into sterling at the usual rate of 2s. 4d. per dollar.

SUMMARY OF OUTPUT, PROFIT AND TAXATION

Name of Company	*Period Ending*	*Ground Treated (000 cu. yd.)*	*Tin Ore Recovery (tons)*	*INCOME*			*EXPENDITURE*		*Profit before Tax* £	*Govt. Tin Royalty (see Ore Sales)* £	*Taxation* £	*Dividends* £
				Ore Sales and Stock (less Govt. Tin Royalty) £	*Tribute Sundry Mine Revenue* £	*Interest Dividends, etc.* £	*Mining Costs* £	*Head Office and other expenses* £				
Malayan Tin Dredging Ltd.	30.6.57	8,675	2,130	1,021,101	18,093	112,870	493,742	113,567	544,755	185,116	153,204	207,000
	30.6.56	8,743	3,201	1,494,164	12,910	102,429	422,977	131,060	1,055,466	270,045	580,146	207,000
	30.6.55	8,243	1,584	690,762	13,141	68,981	339,881	132,150	300,853	126,090	193,728	135,000
Southern Malayan Tin Dredging Ltd.	30.6.57	12,173	2,258*	1,062,293	29,270	78,977	576,734	106,316	487,490	195,781	167,647	276,320
	30.6.56	12,189	2,780*	1,263,847	27,141	72,418	492,751	88,627	782,028	230,020	484,991	276,320
	30.6.55	15,741	3,037*	1,302,496	13,766	45,195	540,311	48,648	772,498	235,127	455,024	266,228
Tronoh Mines Ltd.	31.12.56	9,330	2,633	1,241,916	43,301	112,969	486,899	74,420	836,867	226,858	472,071	273,125
	31.12.55	8,676	2,796	1,249,147	41,708	139,162	440,845	69,126	920,046	228,505	494,401	271,875
	31.12.54	8,330	2,595	1,120,120	42,835	73,868	442,222	62,737	731,864	204,078	405,674	216,375
Southern Tronoh Tin Dredging Ltd.	31.12.56	3,225	735	357,113	2,359	20,246	177,699	29,472	172,547	65,480	91,735	31,625
	31.12.55	3,855	850	376,637	1,140	17,052	187,369	24,700	182,760	69,143	95,877	31,625
	31.12.54	3,413	1,167	500,979	2,830	12,429	178,292	30,314	307,632	92,432	141,761	33,000
Ayer Hitam Tin Dredging Ltd.	30.6.57	2,035	488	231,966	769	37,899	167,076	41,334	62,224	41,983	24,692	35,075
	30.6.56	2,130	713	330,939	621	36,867	157,907	53,853	156,667	58,488	91,630	70,150
	30.6.55	2,176	1,413	625,080	2,796	23,507	145,422	57,444	448,517	112,425	227,259	101,250
Sungei Besi Mines Ltd.	31.3.57	2,561	1,286	595,706	5,110	16,191	359,700	34,941	222,366	112,387	63,610	65,822
	31.3.56	2,583	1,190	542,211	2,392	10,962	327,542	35,844	192,179	97,986	96,458	37,612
	31.3.55	2,284	1,210	528,344	3,128	5,530	326,260	27,691	183,051	95,308	99,027	36,385
Sungei Way Dredging Ltd.	30.6.57	4,742	1,415	672,525	9,294	13,191	394,005†	89,624	211,381	‡	36,272	112,093
	30.6.56	5,370	1,421	659,709	11,860	12,611	336,491†	93,539	254,151	‡	67,560	112,093
	30.6.55	6,958	1,566	687,325	6,623	6,896	391,190	114,905	194,750	‡	42,999	84,070

*Includes recovery from dumps and tribute. †Includes tribute payment of £50,866 in year to 30.6.56 and £48,282 in year to 30.6.57. ‡Not available.

Tronoh-Malayan Tin Group

Malaya Encourages the Foreign Investor

THE year 1957 drew attention to three outstanding dates affecting Malaya. On April 9, 1957, the Chancellor of the Exchequer, in his Budget speech in the House of Commons, introduced a new type of taxation concept—Overseas Trade Corporations. On August 31, 1957, the Federation of Malaya became a free and independent sovereign member of the Commonwealth. And on December 15, 1957, the International Tin Council imposed export controls on tin.

The tranference of power to Malaya ending eighty years of British Administration was bound to raise some doubts as to whether the country could absorb the heady wine of independence without running into economic nationalism. But these fears have up to now proved groundless. The Government made plain from the outset that one of its endeavours would be to attract capital from overseas for the development of its industries by private enterprise. Moreover the development of the country's mining industry was accorded first priority in the Five Year Development Plan. Words have been matched by deeds and the security position was improved substantially last year by the Government's continuous war against Communist terrorists who are now reduced to a hard core. Indeed, the intensive nature of military actions now proceeding gives reason to believe that the intentions of Tunku Abdul Rahman, the Prime Minister, to rid the country of the last remaining terrorists before the first anniversary of Independence Day will be realized. If this should be achieved, the removal of all emergency restrictions would open up extensive jungle areas for prospecting.

The acceptance by the U.K. Treasury of Overseas Trade Corporations in the 1957 Budget meant that, in general terms, those companies controlled from the United Kingdom and developing mineral resources and trade overseas receive some measure of tax relief. The U.K. companies in the Tronoh-Malayan group would be eligible to qualify as Overseas Trade Corporations. Accordingly, tax liabilities in the future can be computed in general as follows:

(1) Income tax and profits tax on investment income.

(2) Malayan income tax on the whole profits overseas.

(3) U.K. income tax on gross distribution at a rate equal to the excess of the U.K. rate of tax over the Malayan rate of tax.

For one year, the transitional period, results in tax liabilities on an abnormally reduced scale, and in the following years the savings are still likely to be appreciable.

Since Malaya is the world's largest producer of tin, the deliberations of the International Tin Council and the decision to impose export controls on tin with effect from December 15, 1957, are of great significance to her economy. Under the terms of the scheme, Malaya's share of the world's exports of 27,000 tons, permitted during the first quota period extending from December 15, 1957, to March 13, 1958, was 37.5 per cent or 10,125 tons of tin metal. The overall cut-back in production required was, therefore, severe but each mine was affected differently as individual company quotas were based on their respective production during the five year period, 1953-1957. For this reason each company's position under the scheme is dealt with individually in the following notes.

As a postscript, however, it is germane to point out that the Tin Research Institute has been praised publicly for its recent successes in the use of organo-tin compounds as pesticides and fungicides and it is hoped that, eventually, these will absorb a considerable tonnage of tin.

MALAYAN TIN DREDGING LTD.

The output of tin ore by Malayan Tin Dredging dropped during the year to June 30, 1957: production in the previous year was, however, exceptionally high, owing to one of the four dredges working high-grade ground—it yielded 1.87 lb. per cu. yd. against an average of 0.82 lb. for all four dredges — the reduction was an expected reaction after the dredge had moved out of the limited area, bringing the average yield for the four dredges down to 0.55 lb. per cu. yd. Even so, the output of 2,130 tons was the second best during the past nine years.

The company owns two areas, each with two dredges: at Batu Gajah, and at Kampong Gajah, but the life of the former area is limited. The Kampong Gajah section has an estimated life of 35 years, after a third dredge, which is being erected, has come into operation. At one time, it had been hoped to install a fourth dredge on the Kampong Gajah section, but that project will undoubtedly be shelved until the outlook is clearer, and the incurring of heavy capital spending justified.

For the first quota period, Malayan Tin had sales of 377 tons, which compares with an actual output of 619½ tons in the December 1957, quarter, and a quarterly average of 532 tons for 1956-57.

SOUTHERN MALAYAN TIN DREDGING LTD.

The company has six dredges, of which one is on the Teja section, and five are on the Tanjong Tualing section. It is planned to transfer one of these to a new property at Degong Road, but these arrangements have not been finalized. One thing is clear, the transfer will involve the expenditure of a considerable capital sum.

The remaining life of the main areas owned by the company has been estimated at 13 years. The deposits on the Degong Road property are expected to be extensive enough to last one dredge for 32 years, but until plans have been completed concerning the equipment of the area, such an estimate is subject to revision.

In addition to the output from the dredges, tin concentrates and ilmenite are being recovered from the amang dumps on the Temoh section.

The company's sales of 586 tons for the first quota period of three and a half months compared with an output of 1,113 tons for the last quarter of 1957. The quarterly average for 1956-57 was only 555 tons.

TRONOH MINES LTD.

The company is recovering tin both in Malaya and, through its subsidiary company, Tin Lay Ltd., in Siam, but the bulk of the tin produced and of the profits earned come from the four dredges operating in the Federation. The dredge with the largest capacity is at Tronoh, the remaining three are on the Kampar section.

The Tronoh dredge has now been converted from oil-fired steam boilers to electric drive. The life of the section will be lengthened as a result, since most of the section's high grade ground has now been worked out and the average grade of ground remaining is lower than the average of recent years.

Satisfactory working is reported from the Kampar dredges; during 1956, one of them, the No. 4, encountered a rich concentration which led to a record recovery for that dredge. Although the amounts won by tributors were small as compared with those produced by the dredges, they yielded a tribute of £29,572 in 1956.

A grab dredge owned by Aokam Tin, financed by the Tronoh-Malayan Tin group, is recovering tin ore from the sea bed off the coast of Siam. Tronoh Mines owns all the capital of Tin Lay Ltd., operating in Siam; the whole of the proceeds from the sale of tin ore in Siam has to be surrendered to the authorities there. And there are delays in getting profits remitted out of the country.

Tronoh's output for 1957 amounted to 2,755 tons against 2,631 tons. The 1958 output will be cut below that level by the

tin restriction scheme: the company's sales for the first three and a half months quota period were 436 tons as compared with an output of 677 tons in the December 1957 quarter.

SOUTHERN TRONOH TIN DREDGING LTD.

Most of the tin ore produced by Southern Tronoh Tin Dredging in recent years has come from the No. 1 dredge. It is, however, nearing the end of the economic life of its present areas, and negotiations are being carried on for leases over two rubber estates in the Sunkai area. Prospecting has proved the existence of 16,000,000 cu. yds. with an average content of 0.56 lb. per cu. yd. This would be sufficient ground for one dredge for about seven or eight years. The authorities responsible for the issue of the leases have delayed the matter for a long time. After the leases are granted, at least one dredge will be moved; the cost of this operation and of acquiring and developing the estate has been estimated at £150,000.

The ground being worked by No. 2 dredge has appreciable quantities of clay, which hampers the task of extracting the values. Special methods of treatment have now been evolved, and the threat of early closure has been avoided. These methods limit the yardage which the dredge can treat, resulting in reduced output and profits, though this is better than the alternative of closing the dredge down.

Under the tin restriction scheme, Southern Tronoh had sales of 138 tons for the first quota period, against actual production of 102¼ tons in the last quarter of 1957. The quarterly average for 1957 was 182 tons.

AYER HITAM TIN DREDGING

Early in 1959, Ayer Hitam expects to have a second dredge, brought over from Australia, in operation, but even then it has sufficient high-grade ground available to last for seventeen years. The cost of purchasing, transferring and erecting the No. 2 dredge will be in the region of £900,000.

Events in the year to June, 30, 1957, proved the wisdom of getting another dredge, for during that period it became necessary to shut the existing dredge down for repairs to the ladder and to carry out other maintenance work. This led to a reduction in the yardage treated and in the amount of tin produced. Another factor responsible for the output of tin ore falling from the comparatively low level of 713 tons in 1955-56, to 488 tons in 1956-57, was the low grade of the ground being worked by the dredge. During the current year the dredge is expected to turn towards the east and to encounter better ground as it advances.

When the second dredge is operating satisfactorily, the present No. 1 dredge will be converted to electric drive, but this is well in the future. Of more immediate concern is the restriction scheme: Ayer Hitam's sales for the first three and a half months quota period were 188 tons. This is above the average for 1956-57 and 1955-56, but much under the level of the preceding years.

SUNGEI BESI MINES LTD.

The two sections owned by Sungei Besi yielded in the year to March 31, 1956, roughly equal quantities of tin ore. The Sungei Besi section uses open-cast methods and the Pelepah section operates a dredge. Of the two methods the dredge recovers tin at a cheaper rate. In order to reduce costs on the open-cast workings a conveyor belt has been installed to replace trucking. This substitution has been so successful that it has been decided to incur the necessary capital expense of bringing in two more belts and eliminating all trucking. One of the effects of using conveyor belts will be to raise the capacity of the section, though this will now have less immediate appeal than when the decision was made some months ago. In order to reach payable deposits on the western side of the leases and to make the task of reaching rich ore below the floor of the present North Open-cast, a road and railway are being diverted. This involves an outlay of about £100,000, but the final results of having more tin ore available and reducing costs are thought to be worthwhile.

Security conditions around the dredge in Johore are difficult. The section being worked by the dredge has an estimated life of seven years.

SUNGEI WAY DREDGING LTD.

This company is incorporated in the Federation, whereas the remaining companies of the group are registered in the United Kingdom. It owns three dredges, all of which were active during the year to June 30, 1957. The ownership of these dredges will enable the board to follow a more flexible production policy during the restriction periods than would otherwise have been feasible. Its sales for the first restriction period were 266 tons, as compared with an output of 423 tons in the December 1957 quarter, and a quarterly average of 354 tons in 1956-57.

The accounts of this company are naturally presented to shareholders in Malayan dollars; in compiling our table below, we have converted into sterling at the usual rate of 2s. 4d. per dollar.

SUMMARY OF OUTPUT, PROFIT AND TAXATION

Name of Company	Period Ending	Ground Treated (000 cu. yd.)	Tin Ore Recovery (tons)	INCOME			EXPENDITURE		Profit before Tax	Govt. Tin Royalty (see Ore Sales)	Taxation	Dividends
				Ore Sales and Stock (less Govt. Tin Royalty) £	Tribute Sundry Mine Revenue £	Interest Dividends, etc. £	Mining Costs £	Head Office and other expenses £	£	£	£	£
Malayan Tin Dredging Ltd.	30.6.57	8,675	2,130	1,021,101	18,093	112,870	493,742	113,567	544,755	185,116	153,204	207,000
	30.6.56	8,743	3,201	1,494,164	12,910	102,429	422,977	131,060	1,055,466	270,045	580,146	207,000
	30.6.55	8,243	1,584	690,762	13,141	68,981	339,881	132,150	300,853	126,090	193,728	135,000
Southern Malayan Tin Dredging Ltd.	30.6.57	12,173	2,258*	1,062,293	29,270	78,977	576,734	106,316	487,490	195,781	167,647	276,320
	30.6.56	12,189	2,780*	1,263,847	27,141	72,418	492,751	88,627	782,028	230,020	484,991	276,320
	30.6.55	15,741	3,037*	1,302,496	13,766	45,195	540,311	48,648	772,498	235,127	455,024	266,228
Tronoh Mines Ltd.	31.12.56	9,330	2,633	1,241,916	43,301	112,969	486,899	74,420	836,867	226,858	472,071	273,125
	31.12.55	8,676	2,796	1,249,147	41,708	139,162	440,845	69,126	920,046	228,505	494,401	271,875
	31.12.54	8,330	2,595	1,120,120	42,835	73,868	442,222	62,737	731,864	204,078	405,674	216,375
Southern Tronoh Tin Dredging Ltd.	31.12.56	3,225	735	357,113	2,359	20,246	177,699	29,472	172,547	65,480	91,735	31,625
	31.12.55	3,855	850	376,637	1,140	17,052	187,369	24,700	182,760	69,143	95,877	31,625
	31.12.54	3,413	1,167	500,979	2,830	12,429	178,292	30,314	307,632	92,432	141,761	33,000
Ayer Hitam Tin Dredging Ltd.	30.6.57	2,035	488	231,966	769	37,899	167,076	41,334	62,224	41,983	24,692	35,075
	30.6.56	2,130	713	330,939	621	36,867	157,907	53,853	156,667	58,488	91,630	70,150
	30.6.55	2,176	1,413	625,080	2,796	23,507	145,422	57,444	448,517	112,425	227,259	101,250
Sungei Besi Mines Ltd.	31.3.57	2,561	1,286	595,706	5,110	16,191	359,700	34,941	222,366	112,387	63,610	65,822
	31.3.56	2,583	1,190	542,211	2,392	10,962	327,542	35,844	192,179	97,986	96,458	37,612
	31.3.55	2,284	1,210	528,344	3,128	5,530	326,260	27,691	183,051	95,308	99,027	36,385
Sungei Way Dredging Ltd.	30.6.57	4,742	1,415	672,525	9,294	13,191	394,005†	89,624	211,381	‡	36,272	112,093
	30.6.56	5,370	1,421	659,709	11,860	12,611	336,491†	93,539	254,151	‡	67,560	112,093
	30.6.55	6,958	1,566	687,325	6,623	6,896	391,190	114,905	194,750	‡	42,999	84,070

*Includes recovery from dumps and tribute. †Includes tribute payment of £50,866 in year to 30.6.56 and £48,282 in year to 30.6.57. ‡Not available.

Redruth-Malayan Tin Group

PRESENT conditions in the Malayan tin industry are very much different from those which existed a year ago. It was thought that the advent of independence for Malaya-Merdeka—would bring a number of political problems. In the circumstances this may have seemed logical, but the problems now facing Malaya are economic, rather than political.

The new independent Malayan Government from the beginning recognized the importance of outside capital and technical assistance in the development of the natural resources of their country, and the urgent need for such interest to be encouraged. At the same time, the mining industry pledged itself to co-operate with the Government in maintaining efficiency and productive capacity.

There are certain problems affecting the mining industry which have yet to be solved, such as the alienation of land for new mining areas, and it is to be hoped that the Malayan Government will appreciate the urgency of this question. The restoration of law and order in certain areas has still to be achieved.

The consequences of the International Tin Agreement, however, are of more importance at the present time than these other considerations. Soon after the establishment of the Buffer Pool it became obvious that the operations of the Pool Manager would not ensure the market price of tin being maintained above the floor price of £730 per ton metal. Consequently the second and, later, third contributions to the Buffer Stock were called up in accordance with the provisions of the International Tin Agreement. Restriction of output was also introduced. This Restriction Scheme operates by means of a control of exports and at first it was believed that a cut of 28½ per cent would be sufficient to bring about the desired balance between supply and demand. Although it was realized that this balance could not be achieved immediately by reason of the fact that it would take some time to dispose of the stocks existing in transit between the smelters and the market, nevertheless the combination of the activities of the Pool Manager and the degree of Restriction was expected ultimately to achieve the required results. This hope, however, was not realized and within six weeks of the institution of the first degree of Restriction the International Tin Council increased it to 40 per cent. The effect of Restriction varies considerably as between producing countries and by the International Tin Council's action it was calculated the Malayan output might be reduced by as much as 48 per cent of normal. Obviously any Restriction of such proportion will have serious repercussions on the affairs of all mining companies in Malaya, although, of course, the respective managements will do everything possible to minimize the effect.

Under the present conditions a strong financial position is of major importance, and those who criticized directors of tin companies in the not too distant past for their conservative attitude towards dividends and the comparatively strong liquid assets of the companies, can now only acknowledge the farsightedness of the men who prepared for the lean years. How long the period of restriction will last cannot be foreseen. That it will eventually be successful seems assured, although that must depend on all the producing countries observing the rules with the same thoroughness as Malaya.

The Malayan Government's contributions to the Buffer Stock have been made in cash, and this is now being recovered from individual producers by means of a cess on gross receipts from ore sales according to the varying price of the metal. This imposes a strain on the liquid resources of the individual mines.

There is a divergence of opinion as to whether these contributions are a current asset or not, and the Redruth-Malayan Tin Group has taken the logical attitude of showing the total of payments made to the Pool as a separate item in the Balance Sheet, since this sum is frozen until the liquidation or partial liquidation of the Buffer Pool.

O.T.C.

If the overseas trade corporation provisions written into the 1957 Finance Act had been granted to the overseas industries a few years earlier the companies, rather than the governments, would have had more of the benefit of the boom periods. As it is, the companies are facing a time when profits will inevitably be smaller than over the last half-dozen years or so, and consequently the tax liability—and relief—will be much reduced. That said, it must also be admitted that those companies which have chosen the status of an Overseas Trading Corporation—some will find it more beneficial because of individual circumstances at least to delay exercising the option—are enjoying a once-for-all return of tax provided but not now required. The proposals to amend the profits tax regulations should also help hard pressed tin companies at the present time in two ways.

Under the old system, the company had a contingent liability to pay profits tax on profits retained if those retentions were later distributed. The very attempt to reckon which profits came from any given year was complex, and the rate of tax which had to be paid varied with the years since the rate at which the rebate was granted on non-distributed profits had been altered on a number of occasions. The Chancellor seems to want to abolish this huge, unwieldy contingent liability, though the provisions have yet to reach the Statute Book. The second way in which the 1958 Budget should assist companies is in its proposals to abolish the differential rates and substitute a flat rate of 10 per cent, though whether this change operates to the advantage of a particular company depends on the proportion of the profits which it distributes.

GOPENG CONSOLIDATED LTD.

Owing to the effect of the International Restriction Scheme on the production and sale of tin, the position of Gopeng Consolidated both as regards profit earning capacity and cash, will be materially different in the year ending September 30, 1958, than in the period under review.

The company's sales for the quota period covering December 15, 1957, to March 31, 1958, were 118¼ tons. This compares with 190½ tons in the quarter ended September 30, 1957, and 214 tons in the preceding quarter. This is a very disappointing result for the work put in to divert the main water supply to the property, the completion of which was restoring the output of tin.

The assets held by the company fall into four main classes; there is first of all its ownership of 2,084 acres of tin-bearing land at Gopeng, Perak, Malaya. It also owns the Moynalpy Rubber Estate of 952 acres, and a half share in Sanglop Rubber Estates. Its third asset is its investment portfolio which, at September 30, 1957, had a book value of £161,557 for the quoted stocks and a market value of £182,598. By far the greatest proportion of these investments was in British Government securities. Approximately 20 per cent, by book value, was in commercial and industrial stocks, and there was about 11 per cent held in Malayan tin and rubber companies. The last class covers spares at the mine, stocks of tin, tax reserve certificates.

On August 30, 1957, a return of 1s. 6d. per 5s. unit was made to stockholders. This was equal to £118,730, comparable to two-thirds of the market value of the quoted securities at end-September 1956. In addition, the contributions to the buffer pool totalling £41,535 during the year under review have, as already indicated, made serious inroads into liquid resources.

RAMBUTAN LTD.

Tin ore production during the year to June 30, 1957, by Rambutan came from two paddocks, though a small output by tribute raised the company's income. Of the two paddocks, the most important is that designated "Z," the amount of ground treated by the hydraulic plant there at 269,269 cu. yd. was roughly double the 132,087 cu. yd. at paddock W2. Paddock "Z" also contains the richer ground, so that the 139 tons produced at this paddock is far greater proportionately than the 34 tons recovered at paddock W2.

This difference in productivity will have an additional significance in the near future, for the ground at paddock "Z" is nearing exhaustion, and although a third paddock, "BC," is being held in reserve its average grade of ore is much lower than paddock "Z." When the time comes, therefore, for paddock "Z" to cease production Rambutan's output of tin will fall, apart from any effects which the International Tin Agreement's restrictions will enforce.

The prospect of Rambutan qualifying as an overseas trade corporation had two important repercussions on the company's finances. It was able to write back £14,722 which had been allocated for 1955-56 tax liabilities; most of this windfall was transferred, in effect, to the general reserve, which received £12,000. The second result was that the total tax liability was reduced. An unqualified comparison of the two payments—£27,624 in 1955-56 with

£10,210 in 1956-57—would be misleading as to the amount of benefit which could come from this innovation, for the tax liability in the latter year would have been lower if only because the untaxed profits at £29,224 were much below the £49,421 of the previous year. It is possible also that the heavy capital expenditure incurred during 1956-57 has had some effect on tax liability. Nevertheless, it is clear that the tax burden will have been lightened by the new tax provisions.

Rambutan's sales under the Tin Agreement were 27½ tons for the first period of three-and-a-half months. It compared with 57¾ tons in the December 1957, quarter, and with the 1956-57 quarterly average of 43 tons. In making the comparisons, however, the effects of the closing of paddock "Z" on output must be remembered. In any case dividends on the shares would have fallen, since the nominal value of the shares has been reduced from £1 to 5s. by the repayment of 7s. 6d. capital in August 1956, and the same amount in February 1957.

TEKKA LTD.

During the last four years, the tin ore output of Tekka Ltd., has been relatively stable around the 140 tons mark. This has been achieved by treating a continuously smaller volume of ground of a higher grade. In spite of this trend the cost of producing a ton of tin ore has risen from £235 in 1953-54 to £373 in 1956-57.

The company owns 981 acres of alluvial tin land in the Kinta area of Perak, Malaya. In October 1956, it was estimated that the life of the property was 15 years.

At one time, the highly favourable liquid position was a feature of the company, but contributions to the buffer pool have frozen some of the assets, to be thawed only when the buffer pool is eventually liquidated. The board has also decided on two capital repayments in recent years. The first was in August 1956, when 5s. per £1 share was returned and in February 1957 when a further 2s. 6d. was returned, bringing the nominal value of the shares down to 12s. 6d. and the net current assets, before the latest pool contributions, to £11,500.

Tekka has been squeezed by the restrictions imposed by the International Tin Agreement; the company's sales for the first quota period were 24 tons, as compared with 49 tons in the December 1957, quarter, and the quarterly average of 35 tons for the last few years. In view of this restriction, which doubtless will have a very serious effect on profits, it is interesting to look at a breakdown of Tekka's income. In 1956-57, the working profits from mine operations, before administration charges or tax, amounted to about £17,200. Interest received on investments, on bank deposits and tax certificates amounted to a gross £8,526. This money was earned on the assets, some of which were utilized in repaying capital. To this extent, the company will not be able to repeat that income during subsequent years; shareholders will, however, have received the income and will derive some income from it themselves.

It might be that shareholders once vocal about the large sums of money being held, will have some pangs of regret that investment income will be dropping at the same time as reduced outputs are being sold at somewhat lower prices.

PENGKALEN LTD.

Pengkalen operates a single dredge on a property in the State of Lahat in Malaya, covering a total of about 1,400 acres. It also derives some revenue from tribute workings, though this is only equal to two per cent of its income from the sale of its own tin. Its sales for the first quota period were 72¼ tons, compared with an actual production of 105½ tons in the September 1957 quarter and 124¾ tons in the previous quarter.

The balance sheet to September 30, 1957, is vastly different from that of 1955-56 since, in August 1957, 80 per cent of the company's issued capital was returned to shareholders, reducing each 5s. share to 1s. This company had an unusual capital structure for a mining concern, since it possessed 10 per cent non-cumulative participating Preferred Ordinary shares as well as the normal Ordinary capital. The rights of Preferred Ordinary capital were well established while the company was operating, but there were doubts whether its rights in a liquidation were in accordance with the intentions held at the time of issue. To clarify this issue, shareholders were asked in March 1958 to agree to the conversion of the Preferred Ordinary shares into Ordinary shares. At meetings held in April 1958, this proposal was accepted and Pengkalen's issued capital now consists of £32,000 in Ordinary shares of 1s. each.

The change in the nominal value of the shares during a financial year makes it desirable to quote the dividend payments in terms of actual cash rather than as a percentage. Pengkalen paid a total of 3s. per Ordinary share during 1956-57, apart from the capital return. The 1955-56 dividends also totalled 3s. per Ordinary share. In each year the Preferred Ordinary capital received an additional 6d. per share.

The new conditions existing in the tin world have compelled the directors to delay consideration of dividend payments until the matter can be seen more clearly.

KENT (FMS) TIN DREDGING LTD.

As its name implies, Kent (FMS) Tin Dredging Co. is engaged in winning alluvial tin from its own and leased areas. These cover 655 acres in the Kuala Lumpur area of Selangor, Malaya; 45 acres on a mining lease direct from the Government and 610 acres on a sub-mining lease, on which tribute is payable, which in 1956 amounted to £3,836. This sum was additional to the £20,563 paid to the Malay Government as tin-gold export duty. Together these sums were equal to £1,826 per acre dredged.

Output in 1956 was 239 tons of tin ore, the fifth successive year in which production was disappointing. This is an indication of the increasing mining difficulties being encountered, for although the yardage treated was somewhat less, the average grade dropped from 0.72lb. per cu. yd. in 1951 to 0.35lb. in 1956. The benefit from the more favourable output in previous years exercised its influence in calculating the quotas for the first three-and-a-half months' period. Kent's share has been fixed at 50 tons as compared with an actual production of 55¼ tons in the last quarter of 1957, and a quarterly average of 60 tons over the whole of the year. Although this is a severe cut, it is of smaller proportions than many other Malayan tin producers.

At the end of 1956, net current assets were roughly £180,000, but these have subsequently been reduced, first, by a capital repayment which reduced the nominal value of the 2s. shares to 1s., an action which distributed £52,500 in cash to shareholders. Buffer Stock Contributions have also been a drain on the Company's liquid resources.

SUMMARY OF OUTPUT, MINING PROFIT AND TAXATION

					LESS				*PLUS*		*PLUS*	*LESS*			
Name of Company	*Period*	*Ground Treated (000) (cu. yd.)*	*Tin Ore Recovery (tons)*	*Ore Sales* £	*Govt. Royalty* £	*Smelters' Charges* £	*Tribute on Ore sold* £	*Mining Expenditure* £	*Sundry Revenue from Tribute,* £	*Mining Profit* £	*Sundry Revenue* £	*Head Office and other Expenses* £	*Profit Before Tax* £	*Tax* £	*Dividend* £
Gopeng Consol.	30.9.57	2,388	869	475,096	74,294	3,969	—	171,467	22,670	248,036	37,821	20,466	265,391	90,193	113,783
	30.9.56	2,006	850	464,503	72,860	3,674	—	147,221	13,650	254,398	30,990	17,788	267,600	154,269	91,026
	30.9.55	1,990	759	389,100	60,465	2,305	—	139,213	12,879	199,996	24,320	14,125	210,191	131,890	113,289
Kent F.M.S. ..	31.12.56	1,520	239	133,655	20,563	827	3,836	105,933	1,599	4,095	3,297	4,839	2,553	1,393	—
	31.12.55	1,489	261	137,126	21,155	853	4,267	94,480	1,191	17,562	3,009	4,716	15,855	11,711	12,075
	31.12.54	1,582	359	182,357	28,086	1,309	4,550	90,972	288	57,728	2,809	7,716	52,821	33,916	23,494
Pengkalen	30.9.57	1,769	470	265,006	40,309	2,150	—	98,971	8,657	132,233	13,737	13,441	132,529	46,888	59,225
	30.9.56	1,776	532	298,102	45,209	2,148	—	94,386	7,074	163,433	12,924	12,972	163,385	96,543	59,225
	30.9.55	1,748	421	219,341	33,306	1,298	3,122	87,388	7,731	101,958	16,635	10,277	108,316	65,626	49,650
Rambutan	30.6.57	402	173	96,649	15,008	786	243	56,670	4,804	28,746	4,793	4,315	29,224	10,210	11,500
	30.6.56	415	200	108,124	16,806	729	301	46,084	4,048	48,252	6,362	5,193	49,421	27,624	18,688
	30.6.55	841	233	117,651	18,234	718	426	45,387	3,635	56,521	4,415	5,849	55,087	31,065	19,750
Tekka	31.3.57	330	144	79,071	12,393	678	—	53,732	4,950	17,218	8,566	3,593	22,191	7,610	10,309
	31.3.56	335	138	73,953	11,569	496	445	45,637	5,093	20,899	10,508	3,460	27,947	14,745	11,597
	31.3.55	377	149	75,713	11,600	504	268	44,019	5,391	24,713	7,172	2,988	28,897	18,387	10,197

LONDON TIN CORPORATION

LIMITED

CAPITAL

Authorised: £4,200,000. *Issued:* £3,618,236, in shares of 4s. each, fully paid

REGISTERED OFFICE - 55-61, MOORGATE, LONDON, E.C.2

PROVIDES, THROUGH ITS SUBSIDIARIES, TECHNICAL MANAGEMENT, FINANCIAL AND SECRETARIAL SERVICES FOR TIN-PRODUCING AND DEVELOPMENT COMPANIES IN MALAYA, THAILAND, BURMA AND NIGERIA

MANAGEMENT ORGANISATION:

(Wholly-owned Subsidiary Companies):—

The Anglo-Oriental and General Investment Trust, Ltd. London

Anglo-Oriental (Malaya) Ltd. Kuala Lumpur, Fed. of Malaya

A. O. Nigeria Ltd. - - - Jos, Northern Nigeria

A. O. (Australia) Pty. Ltd. - - Sydney, N.S.W

Tanjong Tin Dredging Ltd.

TANJONG Tin Dredging Ltd. owns leases and subleases covering 643 acres in the Mukim of Tanjong Tualong in the Kinta District of Perak, Federation of Malaya. Until 1956, the Company also owned 416 acres in Lower Perak which it acquired in 1947 when it purchased the undertaking and assets of Sungei Luas Tin Dredging Ltd. The Sungei Luas 15 cu. ft. bucket dredge was then transferred to the Company's main area where it was reconditioned and re-erected as No. 2 dredge and commenced operations at the end of November 1950. Early in 1956, however, the Sungei Luas area was sold to Lower Perak Tin Dredging Ltd. for £300,000 and out of the profit Tanjong Tin declared two capital Dividends of 5s. and 3s. per 5s. share.

Year to Dec. 31	Ground Dredged (cu. yd.)	Per Cubic Yard Yield (lb.) Tin Ore	Per Cubic Yard Cost (d.)	Output Tons Tin Ore	Price Received per ton Tin Ore (£)
1956	4,345,900	0.68	10.19	1,327	472
1955	4,216,100	0.60	9.8	1,118	452
1954	4,637,100	0.37	8.8	776	421

The Company has two dredges both of which were in operation throughout 1956. Difficult dredging conditions, caused by stiff clay, sand and buried timber were encountered but the yardage treated during the year showed a slight improvement on that treated during 1955 resulting with the help of an increase in recovery from 0.60 lb. to 0.68 lb. per cu. yard, in an output amounting to 1,327 tons of ore. The net taxed profits for 1956 amounted to £155,952, compared with £106,467 in 1955.

From this, dividends totalling 7s. 6d. per 5s. share were declared on the £185,834 issued capital, absorbing £160,281. In addition there were the two special Capital Dividends referred to above.

The financial position of the Company as shown in the Balance Sheet at December 31, 1956, was strong and it is expected that the Company will qualify as an Overseas Trading Corporation with the resultant reliefs from United Kingdom tax.

In the year 1957 production reached 1,056 tons compared with the 1,327 tons obtained in 1956.

The International Tin Agreement came into force on July 1, 1956, and producer countries were required to contribute to the accumulation of a Buffer Stock. Malaya decided to contribute to the Buffer Stock entirely in cash which the Government is recovering from the individual producers by means of a cess each month on the Company's gross receipts from ore sales, the rate of cess varying according to the price of the metal. The sum which Tanjong had had to pay to the Malayan Government as its share of the cess amounted, at the time of the Annual General Meeting held in July last year, to £42,884.

Year to Dec. 31	Total Revenue £	Taxation £	Net* Profit £	Dividends £	To Reserve £	Carry Forward £
1956	645,239	276,500	155,952	160,281	952	21,368
1955	514,136	185,500	106,467	106,274	Nil	23,595
1954	334,792	88,000	31,257	57,144	1,000	23,402

* After write-offs etc.

Kinta Tin Mines Ltd.

KINTA Tin Mines covers more than 1,000 acres situated near Gopeng in the Kinta District, Perak, Malaya. The Company and Gopeng Consolidated Ltd. each have a half interest in the Sanglop Rubber Estate of which some 800 acres are planted with rubber, and Kinta Tin also has a large holding in Tanjong Tin Dredging Ltd.

Year to Dec. 31	Ground Treated (cu. yd.)	Per Cubic Yard Yield (lb.)	Per Cubic Yard Cost (d.)	Output (Tons of Tin Ore)	Revenue per ton of Ore (£)
1956	1,094,000	1.03	22.5	502	455
1955	1,238,300	0.68	17.3	379	440
1954	1,170,800	0.67	16.0	352	416

The method of mining in use at the Company's mines is hydraulicing and until 1955 two sections were worked—the Lallang Section and the Damak Section. But in 1955, the economic limit of the mining paddock at the Lallang Section was reached and, since then, mining operations have been concentrated at a new paddock at the Damak Section. At the Annual Meeting in July 1957 the Chairman stated that exceptionally good returns were being obtained from high grade ground in the Damak Section and he anticipated that a high rate of production would be maintained during 1957 for the first six months of which output had amounted to 361 tons as against 213 tons for the same period in 1956. Good returns continued and the year's provisional total of 717 tons was well ahead of that for 1956.

Total sales of ore during 1956 were up by about 37 per cent in value and, in spite of a rise of 14 per cent in working costs, the profit before tax was over 58 per cent higher at £155,608. The high level of taxation, however, claimed the bulk of the increase and the net result is shown in the table below. Dividends declared from 1956 profits totalled 4s. per share on the 480,000 issued shares of 5s. against 3s. 9d. per share in the preceding year.

At an Extraordinary General Meeting held in February 1956, a repayment of Capital of 2s. per share was authorized and resolutions passed to restore the Issued Share Capital to its original figure. A transfer of £48,000 from General Reserve was made for this purpose and payment was made to shareholders in the following April. A further Capital Repayment of 3s. per 5s. share was approved at an Extraordinary General Meeting held in November 1956 and, the sanction of the court having been obtained payment was made to shareholders in February 1957. The authorized Share Capital of the Company now remains at £120,000 but the issued Share Capital has been reduced by the second Capital distribution to £48,000 divided into 480,000 shares of 2s. each. In addition, the sum of 1s. per share was distributed in the form of two Capital Dividends, arising from Capital Dividends received by the Company from its holding in Tanjong Tin Dredging.

The financial position of the Company remains strong and this renders the Company as well able as any to face the extremely high degree of restriction imposed under the operation of the International Tin Agreement. It is expected that the Company will qualify as an Overseas Trading Corporation and will enjoy the tax reliefs resulting therefrom.

For remarks regarding the coming into force of the International Tin Agreement see Tanjong Tin Dredging Ltd. above. The sum which Kinta Tin paid to the Malayan Government on account of Buffer Stock contributions at the time of the Annual General Meeting in July 1957, amounted to £21,926.

Year to Dec. 31	Total Revenue £	Taxation £	Net Profit £	Dividends £	To Reserve £	Carry Forward £
1956	267,911	99,442	52,479	55,200	Nil	22,612
1955	197,679	57,610	31,376	51,525	Nil	25,333
1954	163,066	40,275	32,255	28,350	1,000	21,782

Petaling Tin, Ltd.

OPERATIONS of Petaling Tin, the important Malayan incorporated tin producer, over the last two years has been characterized by heavy capital expenditure coinciding with a comparatively low rate of production. Indeed, in respect of the year ended October 31, 1956, this twin force of adversity resulted in the dividend being slashed to 15 per cent from 85 per cent while, in the year under review—the 12 months ended October 31, 1957—the sustained pressure of this combination prevented any payment at all being made to shareholders.

The rot set in, as it were, about two years ago when the virgin ground being worked by the No. 5 dredge, expected to yield 0.43 lb. per cu. yd., failed to yield anything like this value and both the area, the recently acquired Seaport Estate, and the No. 5 dredge were temporarily retired: the Estate pending a closer re-examination and the dredge pending the results of that examination being favourable. In the event, the Seaport Estate has been described as uneconomic under current conditions so that the company is, in the short run, dependent on its other three dredges.

No. 3 dredge, a deep digging unit, continues to operate satisfactorily. But No. 4 dredge, modified to dig at greater depths, was inactive for several months through the delay in equipment arriving from the U.K. The conversion was completed in April, 1957. The No. 6 dredge, which has the greatest capacity and digging depth of the company's four dredges, has unfortunately been working ground already dredged by the No. 5 dredge for a large proportion of the year with disappointing results, although when it was operating in virgin ground during the first six months of the year under review results were very satisfactory.

The other adverse feature of the company's operations over the past two years has been the high rate of capital expenditure which, during the year under review, included £34,473 on the rehabilitation of the No. 4 dredge; £37,440 on the deviation of the Klang River, the further payment of £20,000 for the purchase of 600 acres of the Castlefield Estate and the sum of £48,908 as contributions to the Tin Buffer Stock. In the year ended October 31, 1956, capital expenditure—excluding the Tin Buffer Stock contribution—totalled £302,982.

These heavy outgoings were met by a Bank overdraft in preference to selling, at a loss, the company's holdings of dated securities built up over the years to finance such commitments. After debiting this loan, Petaling's net current assets amounted to £472,274 and compares with an issued capital of £513,333 in 4,400,000 shares of $1 each.

Mr. J. T. Chappel in his statement from the chair in February last said that the company's return to the list of dividend payers was "dependent on a substantial improvement in returns." This, in fact, is dependent upon the relaxation of quota restrictions which, at the present rate, will allow Petaling to produce only about 90 per cent of last year's output.

The outlook for the current year is, in many respects, good. The No. 6 dredge will have six or seven months' working in virgin ground and the areas allocated to the No. 3 and No. 4 dredges ought to prove at least as remunerative as during the year under review. Moreover, it is certain that the price received per ton tin ore will be considerably higher than that attained during 1956-1957.

Year to Oct. 31	*PRODUCTION RESULTS*						*FINANCIAL RESULTS*				
	Treated (000 cu. yd.)	*Per cu. yd.*		*Output*	*Per ton*		*Mining Revenue†* (£)	*Mining Costs‡* (£)	*Taxation* (£)	*Dividend* (£)	*Carry Forward* (£)
		Yield (lb.)	*Cost (d.)*	*(Tons of conc.)*	*Cost* (£)	*Price** (£)					
1957	8,279	0.31	11.8	1,129	361	441	531,054	407,294	Nil	Nil	115,588
1956	10,102	0.25	9.73	1,133	362	499	530,208	409,681	16,660	53,900	92,914
1955	9,503	0.49	8.55	2,088	162	430	909,762	338,622	135,613	305,433	122,878

*Less tribute. †From tin-ore, gold, ilmenite and tribute collected. ‡Including provision for plant renewals.

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11/12, ST. SWITHIN'S LANE,
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CAPITAL

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Siamese Tin Syndicate Ltd.

Ten Operative Dredges

HAVING been operating for 50 years in Siam, the Siamese Tin Syndicate is slowly spreading its interests beyond the confines of Thailand, though by far the greatest portion of its activities is in that country and, so far as can be seen that will continue to be so. It is rehabilitating an old lead-zinc property in Scotland and, in company with Rio Tinto and Le Nickel S.A., the Syndicate is participating in an extensive exploration programme over a large area in Western Queensland. A property in Western Australia was investigated recently, but was not found to be attractive enough.

The Syndicate owns 11 dredges in the Far East: until recently 10 were in active operation. During the current year, however, five of the 10 dredges will be closed down for substantial periods.

The dredge at Huey Moot has the longest estimated life. At the end of 1956, dredging reserves stood at over 22,000,000 cu. yd., sufficient for 12-13 years' working, and check boring has indicated that payable values might continue over the northern boundary. In order to ascertain whether this is so or not, an exclusive prospecting lease has been taken out and early results of the boring are reasonably encouraging. This dredge is being re-equipped with diesel electric power and other devices designed to make a marked improvement in running costs which should amply repay the heavy capital expenditure.

The two dredges at Bangrin can expect to continue operations for a further eight years, and there is a possibility of extending this period if some low grade ground to the north of the existing leases can be obtained.

Next in the list of areas with reserves sufficient for the next few years come Kota Bahru. Here the reserves are estimated to last eight years. The dredge was closed down in the earlier months of 1957 for electrification and this plant is now in a position to be a main prop for profits as other dredges receive similar re-conditioning. The costs of production in 1956 were £655 per ton of metal, as compared with the average price received of £758; the change should effect a significant costs reduction.

The Koe Kein and the Katu dredges each have a life expectation of about six years. The grade of the Koe Kein area is rather low; during 1956, its average output was only 0.32 lb. per cu. yd. as compared with the average of 0.50 lb. per cu. yd. for all dredges, and 0.77 lb. for the neighbouring Peek dredge.

The Katu area has an estimated life of about six years, having been increased by the addition of 1,364,000 cu. yd. in an adjoining property, which extended the reserves for an extra nine months or so. Old tailings in the northern leases can also be re-treated, though their grade must be reckoned to be low.

Renong provided in 1956 the largest tonnage from any of the single dredge areas, but it has been announced that its reserves will be exhausted about the middle of 1958. This would have a rather depressing implication, but for the fact that when the present area has been finally worked out, the dredge will be transferred to the new Bangnon property, whose life has been officially described as "extensive."

Altogether the above-mentioned seven dredges accounted for 70 per cent of 1956 production, and a roughly similar proportion of the 1955 output.

The remaining dredges are nearly at the end of their economic production. Two of them are at Ngow where the reserves are on the point of exhaustion, and where unfortunately no new ground is available, so that they may be expected soon to cease production. The third, at Peek, exhausted its own reserves in October, 1956, and is at present working neighbouring leases on a tribute basis. This is only a temporary measure, and the dredge is expected to cease production finally during 1958.

Year to Dec. 31	1954	1955	1956
Cu. yd. (000)	10,330.4	11,587.9	15,979.9
Tin ore (tons)	1,998	2,685	3,656
Lb. per cu. yd.	0.43	0.51	0.50
Price received	£674	£705	£758

Production fell from 3,656 tons in 1956 to about 3,300 tons in 1957, which was a decline of 11 per cent and was combined with a lower price for the metal. The current year would in any case have been still less favourable even if the tin metal market had been normal, since output would have reflected the suspension of operations for shorter or longer periods of five of the dredges; but the tin restriction scheme has hit the Syndicate with particular severity: its allowable export quota for the first half of 1958 was 1,531 tons, so that output will be only a little over one-third. What the future has in store for this company, or for other tin mining companies, it is not possible to foretell, but there must be grave doubts whether much in the way of profits is being earned at the moment. Although the Syndicate has been fortunate in that, since restriction was necessary, it should have come at this time, it must be remembered that when restrictions are eased or abolished, Siamese Tin may perhaps be operating only seven dredges.

During the financial year ended December 31, 1956, Siamese Tin achieved another large increase in production, owing to the inclusion for the first time of a full year's production from two of the dredges, Renong and Katu, and to greatly improved production from Huey Moot. This latest expansion in output has established a company record of 3,656 tons of tin concentrates, an improvement of 971 tons over the previous year, and almost double the output of 1954, when the grade of the ground dredged was much lower.

Once again average mining costs were reduced, though naturally costs from dredge to dredge varied widely both in size and direction. The incidence of export duty, however, increased appreciably and the final result was a small increase in total costs. The company absorbed this rise since it obtained a better price for its tin.

The Syndicate has been unlucky in the time at which Lowland Lead Mines came into production, since this was the period when lead and zinc prices, stable for so long, plunged to their present uneconomic levels. However, the late Mr. Robert Scott, chairman until his death in 1957, said that he saw no cause for despondency once the mill had settled down and higher grade material came to be treated. At the end of 1956, indicated ore reserves totalled 102,000 tons and inferred reserves 83,000 tons; in addition, surface dump material amounted to 154,000 tons and old fill to 108,000 tons. No credit was taken in the indicated ore reserves for ore below the 8th level, though some shoots still persist below that level. However, owing to the low metal prices the mine was placed on a care and maintenance basis earlier this month.

	1954	1955	1956
	£	£	£
Revenue	273,276	516,719	799,186
Taxation	127,894	276,266	445,809
Net profit....	122,031	215,078	324,905
Dividends....	92,888	141,381	188,508
To reserve ..	Nil	12,483	50,000
Carry forward	62,936	60,041	96,004

The Syndicate's general financial position continues to be strong. Its current assets totalled £2,140,713 at end of December, 1956. Current liabilities, of which rather over one-third are classified as being abroad, totalled £887,524, leaving net current assets at end of 1956 equal to roughly 11s. 6d. per stock unit. A note to the balance sheet states that capital commitments not included are estimated at £130,000, and this will have been subsequently increased by the additional calls made by the manager of the tin buffer pool for further contributions. The group will, of course, need to command resources should it be successful in any of its other projects, as well as to weather the present storm.

The overseas trade corporation provisions of the Finance Act bring tax relief at a time when all tin companies can well do with this overdue amelioration of their difficulties. It has been necessary to hive off Lowland Lead Mines, which is operating in this country, and hence, rather ironically, receives no tax relief; clearly in this case, charity does not begin at home! Further arrangements have been made, involving the registration of a wholly-owned subsidiary in the Bahamas, the Bahamas Mineral and Investment Co. Ltd., to take over 75 per cent of the share capital of the Renong and Katu companies, acquired in 1955. In this way, U.K. tax will only be paid on the remaining 25 per cent and on such profits relating to the 75 per cent just mentioned as is remitted to the U.K. for distribution. Thus, the company will be able to build up its financial position still further, though any transfer of these Bahamas profits would attract a heavy liability for U.K. tax.

Malaya

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The dredge at Huey Moot has the longest estimated life. At the end of 1956, dredging reserves stood at over 22,000,000 cu. yd., sufficient for 12-13 years' working, and check boring has indicated that payable values might continue over the northern boundary. In order to ascertain whether this is so or not, an exclusive prospecting lease has been taken out and early results of the boring are reasonably encouraging. This dredge is being re-equipped with diesel electric power and other devices designed to make a marked improvement in running costs which should amply repay the heavy capital expenditure.

The two dredges at Bangrin can expect to continue operations for a further eight years, and there is a possibility of extending this period if some low grade ground to the north of the existing leases can be obtained.

Next in the list of areas with reserves sufficient for the next few years come Kota Bahru. Here the reserves are estimated to last eight years. The dredge was closed down in the earlier months of 1957 for electrification and this plant is now in a position to be a main prop for profits as other dredges receive similar re-conditioning. The costs of production in 1956 were £655 per ton of metal, as compared with the average price received of £758; the change should effect a significant costs reduction.

The Koe Kein and the Katu dredges each have a life expectation of about six years. The grade of the Koe Kein area is rather low; during 1956, its average output was only 0.32 lb. per cu. yd. as compared with the average of 0.50 lb. per cu. yd. for all dredges, and 0.77 lb. for the neighbouring Peek dredge.

The Katu area has an estimated life of about six years, having been increased by the addition of 1,364,000 cu. yd. in an adjoining property, which extended the reserves for an extra nine months or so. Old tailings in the northern leases can also be re-treated, though their grade must be reckoned to be low.

Renong provided in 1956 the largest tonnage from any of the single dredge areas, but it has been announced that its reserves will be exhausted about the middle of 1958. This would have a rather depressing implication, but for the fact that when the present area has been finally worked out, the dredge will be transferred to the new Bangnon property, whose life has been officially described as "extensive."

Altogether the above-mentioned seven dredges accounted for 70 per cent of 1956 production, and a roughly similar proportion of the 1955 output.

The remaining dredges are nearly at the end of their economic production. Two of them are at Ngow where the reserves are on the point of exhaustion, and where unfortunately no new ground is available, so that they may be expected soon to cease production. The third, at Peek, exhausted its own reserves in October, 1956, and is at present working neighbouring leases on a tribute basis. This is only a temporary measure, and the dredge is expected to cease production finally during 1958.

Year to Dec. 31	1954	1955	1956
Cu. yd. (000)	10,330.4	11,587.9	15,979.9
Tin ore (tons)	1,998	2,685	3,656
Lb. per cu. yd.	0.43	0.51	0.50
Price received	£674	£705	£758

Production fell from 3,656 tons in 1956 to about 3,300 tons in 1957, which was a decline of 11 per cent and was combined with a lower price for the metal. The current year would in any case have been still less favourable even if the tin metal market had been normal, since output would have reflected the suspension of operations for shorter or longer periods of five of the dredges; but the tin restriction scheme has hit the Syndicate with particular severity: its allowable export quota for the first half of 1958 was 1,531 tons, so that output will be only a little over one-third. What the future has in store for this company, or for other tin mining companies, it is not possible to foretell, but there must be grave doubts whether much in the way of profits is being earned at the moment. Although the Syndicate has been fortunate in that, since restriction was necessary, it should have come at this time, it must be remembered that when restrictions are eased or abolished, Siamese Tin may perhaps be operating only seven dredges.

During the financial year ended December 31, 1956, Siamese Tin achieved another large increase in production, owing to the inclusion for the first time of a full year's production from two of the dredges, Renong and Katu, and to greatly improved production from Huey Moot. This latest expansion in output has established a company record of 3,656 tons of tin concentrates, an improvement of 971 tons over the previous year, and almost double the output of 1954, when the grade of the ground dredged was much lower.

Once again average mining costs were reduced, though naturally costs from dredge to dredge varied widely both in size and direction. The incidence of export duty, however, increased appreciably and the final result was a small increase in total costs. The company absorbed this rise since it obtained a better price for its tin.

The Syndicate has been unlucky in the time at which Lowland Lead Mines came into production, since this was the period when lead and zinc prices, stable for so long, plunged to their present uneconomic levels. However, the late Mr. Robert Scott, chairman until his death in 1957, said that he saw no cause for despondency once the mill had settled down and higher grade material came to be treated. At the end of 1956, indicated ore reserves totalled 102,000 tons and inferred reserves 83,000 tons; in addition, surface dump material amounted to 154,000 tons and old fill to 108,000 tons. No credit was taken in the indicated ore reserves for ore below the 8th level, though some shoots still persist below that level. However, owing to the low metal prices the mine was placed on a care and maintenance basis earlier this month.

	1954	1955	1956
	£	£	£
Revenue	273,276	516,719	799,186
Taxation	127,894	276,266	445,809
Net profit....	122,031	215,078	324,905
Dividends....	92,888	141,381	188,508
To reserve ..	Nil	12,483	50,000
Carry forward	62,936	60,041	96,004

The Syndicate's general financial position continues to be strong. Its current assets totalled £2,140,713 at end of December, 1956. Current liabilities, of which rather over one-third are classified as being abroad, totalled £887,524, leaving net current assets at end of 1956 equal to roughly 11s. 6d. per stock unit. A note to the balance sheet states that capital commitments not included are estimated at £130,000, and this will have been subsequently increased by the additional calls made by the manager of the tin buffer pool for further contributions. The group will, of course, need to command resources should it be successful in any of its other projects, as well as to weather the present storm.

The overseas trade corporation provisions of the Finance Act bring tax relief at a time when all tin companies can well do with this overdue amelioration of their difficulties. It has been necessary to hive off Lowland Lead Mines, which is operating in this country, and hence, rather ironically, receives no tax relief; clearly in this case, charity does not begin at home! Further arrangements have been made, involving the registration of a wholly-owned subsidiary in the Bahamas, the Bahamas Mineral and Investment Co. Ltd., to take over 75 per cent of the share capital of the Renong and Katu companies, acquired in 1955. In this way, U.K. tax will only be paid on the remaining 25 per cent and on such profits relating to the 75 per cent just mentioned as is remitted to the U.K. for distribution. Thus, the company will be able to build up its financial position still further, though any transfer of these Bahamas profits would attract a heavy liability for U.K. tax.

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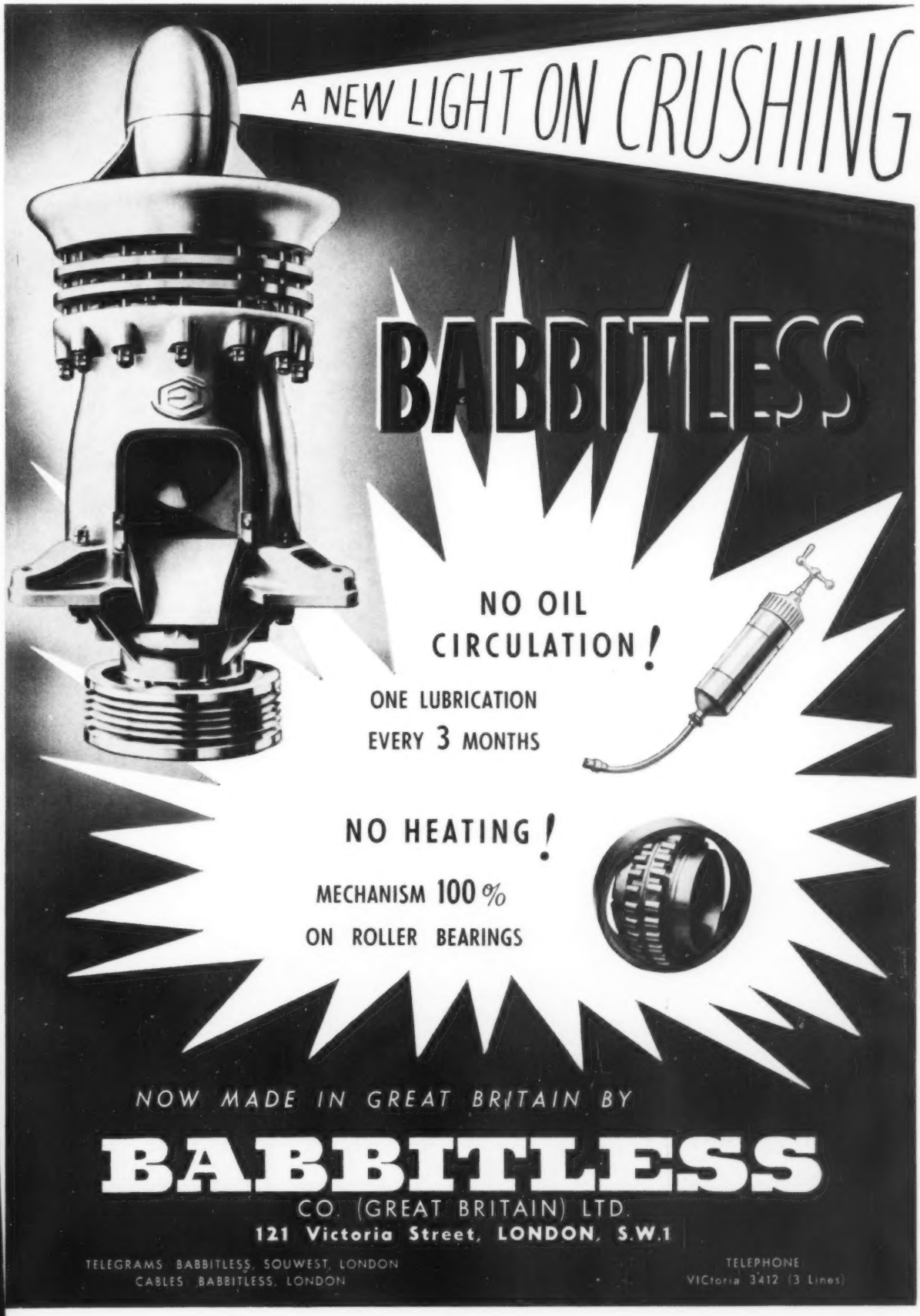
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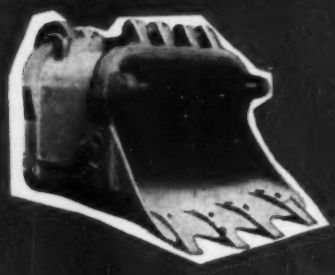

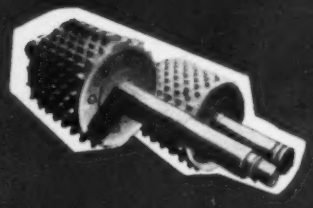

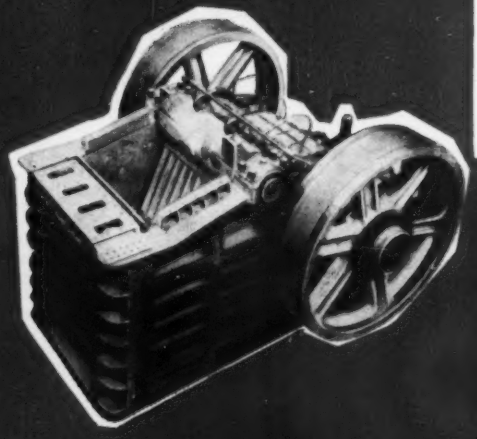

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